Hydrozone Design:
Resources in Support of Water-Conserving Landscape Ordinance Design Requirements
in Pasco County, Florida

In Partial Fulfillment of the Requirements
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Presented to:
The Department of Landscape Architecture
Graduate Thesis Committee
Margaret Carr
Glenn Acomb

Designed and Written by:
Dänika Rain Randolph
Graduate Student
Department of Landscape Architecture
University of Florida

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TABLE OF CONTENTS

List of Figures

ABSTRACT

Sustainable design practices can mitigate the effects of natural resource degradation caused by traditional land development. The case study area for this project, Pasco County, is an area of Florida prospering from rapid development but struggling to conserve present and future water resources. To meet the critical goals of water conservation, the state of Florida adopted "Florida-Friendly" or "Xeriscape™" legislation in 2001, endorsing Xeriscape™ practices as "an essential part of water conservation planning," and requiring the Water Management Districts to encourage and incentivize adoption by local governments of Xeriscape™ measures into landscape ordinances requirements. The landscape design requirements of five model water-conserving landscape ordinances analyzed for this project emphasize certain strategies for conserving water through landscape design, including: (1) grouping plantings into water demand zones (hydrozones) based on microclimate considerations; and (2) requiring the preservation of native plant communities and/or encouraging the use of native plants. The first strategy, referred to as the "hydrozone concept," suggests a different conceptual basis for landscape design that compels designers to relate levels of water use with levels of human activity and with the ecological conditions of the site. The hydrozone concept, in turn, drives plant selection and placement based on three levels/zones of water demand/soil moisture preference: high, medium, and low (Oasis, Drought-Tolerant, and Natural zones, as described in typical Xeriscape™ references). The second strategy, preservation of native plant communities and use of native plants, considers existing vegetation to be existing areas of low water use, and encourages the use of native plants that fall into low water use categories for easier establishment, increased drought-tolerance, and regional eco-restoration. The Design Resources created for this thesis project are the Hydrozone Plant Selection Guide and the Natural Plant Community Guide, which offer tools in support of strategies one and two, respectively. These resources are intended to support the water-conservation goals of model landscape ordinances, as well as challenge the creative goals of landscape architects and sustainable designers in Florida.

Introduction

A movement toward encouraging more sustainable land development practices is growing all over the United States, and Florida is no exception. Sustainable land development practices can help mitigate the effects of sprawl, so state and local governments are exploring ways that land development regulations can help to protect natural resources without discouraging positive economic growth in fast-growing regions of the state. One vital area of concern in Florida is water conservation. To this end, many land development regulations and landscape ordinances are being revised to encourage, if not require, more water efficient landscape and irrigation design. There are a number of model landscape ordinances created by state and local governments, industry organizations, and non-profit groups that address water conservation needs in Florida. These model ordinances typically require that landscape designers use a handful of new approaches to minimize the use of potable water for irrigation, including (1) grouping plant selections into homogenous water-use categories, or hydrozones, as well as considering the effect of microclimate, especially the degree of sun/shade present when assigning plants to hydrozones; (2) requiring the preservation of native plant communities and/or encouraging the use of Florida native plants for easier establishment, increased drought-tolerance, and regional eco-restoration; and (3) minimizing or limiting the area dedicated to turfgrass in landscape planning.

These model water conservation landscape ordinances have been gaining favor since the state adopted Xeriscape™ as

"an essential part of water conservation planning" in 2001, and since the state required Florida's five regional Water Management Districts (WMDs) to design and implement incentive programs for local governments to adopt or amend existing ordinances to include Xeriscape™ measures (Section 166.048 F.S. and Section 373.185 F.S.). One of the seven principles of Xeriscape™ is "Choose Proper Plants," or "Right Plant, Right Place," and includes a discussion of native plant communities, and planting for efficient water use. The suggestions for efficient water use focus on grouping plants according to their water needs, or "hydrozones."

Landscape architects and designers in Florida will be expected to rise to the challenges of the new design requirements in these more sustainable landscape ordinances as they become adopted all over the state. However, when regulations create new expectations for landscape plan submittals, every effort should be made to provide those affected by the changes with the best tools to fulfill those new requirements. In the case of the model water conservation landscape ordinances' typical landscape design requirements, the hydrozone requirement is a potentially effective proposal; but to be truly effective, landscape architects and designers—as well as plan reviewers—need new resources to assist them in making new requirements a successful reality. Using Pasco County, Florida, as a case study, the new resources proposed and demonstrated by this thesis project are (1) the **Hydrozone Plant Selection Guide** that will provide designers with a plant selection reference organized by three levels of water demand (consistent with the three zone types associated with Xeriscape™ practices) and by microclimate considerations,

primarily sun/shade requirements and soil drainage types; and (2) the **Natural Plant Community Guide** that includes two elements: sample **Natural Plant Community Maps**, and a **Natural Plant Community Plant List**, both of which will assist designers who take on the challenges of preserving native vegetation and designing with native plants.

The need for these tools is fast approaching, as water issues continue to surge to the forefront in Florida, as landscape architects and designers take on increasingly important roles in development and growth management, and as sustainability issues become increasingly important to the public.

This project begins with a discussion of what sustainable development means, how it translates into design, and how sustainability applies to land development. Next is a review of the regulation of land development in Florida and an explanation of how landscape ordinances can be a tool for encouraging sustainable land development at the local level. In Chapter Three, the important issue of water conservation in Florida is explored and how it is addressed at the state and local government levels is discussed. Information about Pasco County, its ecological character, its current need for water conservation measures, and its suitability as a case study is next. Strategies for water conservation in landscape design are addressed, and an analysis of five current model water-conserving landscape ordinances demonstrates how these strategies have influenced regulatory standards. The implications of the "hydrozone concept" on the landscape design process suggest that practical measures for water conservation are, in fact, creating a need for a flexible

sustainable landscape design process. What follows are the proposed new resources developed as a part of this project, the **Hydrozone Plant Selection Guide** and **Natural Plant Community Guide,** which are offered as sustainable design tools in support of the water-conserving measures in current model landscape ordinances. And finally, Chapter Seven discusses the future of Florida landscape architects' roles as sustainable landscape designers.

Chapter One: Sustainable Land Development

The Concept of Sustainability

'In our every deliberation, we must consider the impact of our decisions on the next seven generations.'

From the Great Law of the Iroquois Confederacy

Every day there are an increasing number of magazine articles, newspaper commentaries, trade journal headlines, and special-interest books published that promote the idea of "sustainability." The concept of sustainability has been touted as a saving grace for nearly every aspect of 21st century living, from sustainable building practices to sustainable community development to sustainably harvested lumber. Despite the growing prevalence of the term, many people are still uncertain about its exact definition. For many people, "sustainability" has become synonymous with "green" or "organic" or "earth-friendly," or any word that embodies environmental good. Although those terms are somewhat accurate, sustainability requires an understanding of its basic assumptions as well as a practical understanding of its meaning in order to explain the benefits and limitations of promoting it and practicing it. One way to understand sustainability is to analyze its most common definitions.

Sustainable development was defined by the World Commission on Environment and Development (WCED) in 1987 as, "meeting the needs of today's population without diminishing the ability of future populations to meet their needs" (Steiner, 2000, p11). This is a useful general definition, because it allows for a range of interpretations: A population, for example, can be a group of people, or of plants, or of soil microbes. The term "needs" can be thought of as a human

standard of living, or the diversity of wildlife or plant habitat, or the availability of soil nutrients. This means that the concept of sustainability can apply to many different aspects of life. This is the first most important element of sustainability; it is both *context-specific* and *universal*. Again, a "population" can mean a stand of old-growth trees as easily as it can mean an urban low-income neighborhood of people; both populations have needs that can be addressed using the concept of sustainability, but each population's needs will be completely different.

Look more closely at the basic verb/noun structure of WCED's definition: "meeting the needs….without diminishing the ability." This basic structure begins to explain the idea of *balance*, which is the second important element of sustainability. Meeting one's needs without diminishing the ability of others to meet their needs is like a see-saw in a playground; for both kids to stay up in the air, each has to push off the ground with a certain amount of force and balance, no matter their respective weights, so that they can both swing their legs in the air. It is cooperative action for mutual benefit; it is meeting one's needs without diminishing the other's ability to meet his or her needs.

Finally, observe the terms "today" and "future." The third important element of sustainability is recognizing the difference between the tangible "now," and the intangible "then." The basic assumption of *cause and effect* is wrapped up in this element; actions, or choices, which we make now have an effect on our own, or others', choices in the future.

There are many definitions of sustainability—some more useful than others—and all of them try to capture the

important elements of sustainability in a slightly different way. For the purposes of this thesis project, definitions that relate to sustainability in terms of land development and resource protection will provide the best basis for understanding.

National professional organizations, like the American Institute of Architects (AIA), the American Planning Association (APA), the American Society of Landscape Architects (ASLA), and regional professional organizations, like the Association of Florida Native Nurseries (AFNN), define sustainability and sustainable development in terms that are useful for the pursuit of their professions: land development. For example, the American Institute of Architects defines sustainability as, "the ability of society to continue functioning into the future without being forced into decline through exhaustion or overloading of the key resources on which that system depends" (Mendler, 2000, p1-2). This definition uses the more specific term "society," rather than the general term "population," but it captures the other elements of balance and present/future choices.

The American Planning Association created a "Policy Guide on Planning for Sustainability" that was adopted and ratified by the organization in April 2000. The APA Policy Guide defines the "issue" of sustainability as a question of "whether the Earth's resources will be able to meet the demands of a growing human population that has rising aspirations for consumption and quality of life, while maintaining the rich diversity of the natural environment or biosphere" (www.planning.org/policyguides/sustainability). This

definition is more clearly aimed at the balance between human populations and the Earth's resources.

The American Society of Landscape Architects' policy statement on environmental sustainability defines it as "the capability of natural and cultural systems to maintain themselves over time[; it] is supported by individual and collective motivations to use low impact and less consumptive approaches in our interactions with other people and the environment" (www.asla.org). This is a more sweeping statement that captures the ideas of balance (individual and collective), maintenance over time, and need for the natural systems/cultural systems to mutually benefit.

Donaldson, of the Association of Florida Native Nurseries, writes "Sustainable Landscaping: What Does It Mean? Nowadays, conservationists and public policy makers spend a lot of time discussing 'sustainability' and the earth's 'carrying capacity.' Why? Because our future is threatened by some modern practices, such as consuming limited or non-renewable resources. Water, for example, has always seemed abundant and either 'free' or low cost, but as our population grows and the climate changes, water may become less available and more costly. What is more important—eating and bathing, or watering the lawn? As our population grows, we have to find alternatives and in many cases, change the way we do things so that our quality of life can be sustained" (AFNN Plant & Service Directory, 2002-2003, p23). In this discussion, Donaldson takes the basic definition a step further to suggest that "finding alternatives," and "changing the way we do things" is what sustainability means.

These definitions show how professional organizations define sustainability and sustainable land development to understand how it applies to their professions, but what about the average American's view of sustainability? Public agencies, like those in the federal government, offer definitions of sustainability to help the public understand sustainable development. The Smart Communities Network, a Project of the U.S. Department of Energy, describes sustainable development as, "a strategy by which communities seek economic development approaches that also benefit the local environment and quality of life….[M]any communities…have discovered that traditional approaches to planning and development are creating, rather than solving, societal and environmental problems. Where traditional approaches can lead to congestion, sprawl, pollution and resource overconsumption, sustainable development offers real, lasting solutions that will strengthen our future. Sustainable development provides a framework under which communities can use resources efficiently, create efficient infrastructures, protect and enhance quality of life, and create new businesses to strengthen their economies. It can help us create healthy communities that can sustain our generation, as well as those that follow ours" (www.sustainable.doe.gov/overview). The DOE definition is designed to highlight what sustainable development can do for the pubic good, and it is described in terms of progress, health, and quality of life.

Each of these definitions and discussions attempts to communicate the ways that sustainability can benefit humankind and the earth's resources. But is it all idealized?

Are these definitions good theories with no practical means of making sustainability happen? Are these just "feel-good" words and phrases that fail to acknowledge the hard choices needed to protect environmental quality?

Criticisms of Sustainability

As Thompson and Sorvig note, critics are quick to point out that there are limits to the concept of sustainability, both in theory and in practice; for example, "[t]he 'present/future needs' definition of sustainability can be criticized for oversimplifying several key questions: Which population's needs are to be met? How large a human population can be sustained? Where do we draw the line between 'needs' and desires?" (Thompson & Sorvig, 2000, p3). That first important element of sustainability, that it is context-specific and universal, can make it difficult to know where to "draw the line." Thompson and Sorvig provide these examples to illustrate: "If nonpolluting, low-maintenance landscapes covered the globe, at the expense of wild species and places, would that be a sustainable world? Is there any way to avoid impoverishing the natural world without placing drastic limits on human population, land use, and resource consumption? For a majority of the world's population, 'landscape' equates to crops, firewood, and survival. In such economies, public parks and private gardens are fantasies far beyond reach, glimpsed on TV or through closed gates. Does this mean that all landscape construction should be sacrificed to achieve subsistence-level sustainability?" (Thompson &

Sorvig, 2000, p3). There are no easy answers to these questions.

Even more troubling, why is one method or technique considered more sustainable than another? To use a common example, solar panels are widely considered to be a more sustainable "green" method for conserving energy—after all, alternative power sources, like sun and wind, are free—but if the energy required to manufacture and produce a solar panel is far greater than the amount of energy each panel will produce in its lifetime, is there energy savings at all? This is a question of "embodied energy" costs. Embodied energy is "the total energy used to produce something—either a single material, a complex product, or a whole project" (Thompson & Sorvig, 2000, p243). Some would say that investing in technologies like solar panels increases the likelihood that manufacturers will continue to research ways to make them more energy-saving from start to finish, and despite the high energy costs of production, they are still a "more sustainable" choice because they will function for many years "off the grid" and contribute to energy savings in the immediate area. Life-cycle costing (LLC) is an established and respected technique for comparing sustainable methods to conventional methods, but there are difficulties, like a lack of comparable source data, that limit the practice. Given these challenges, how easy is it to make the final call on what's more or less sustainable? How does a designer or a homeowner know what's a better choice?

Some critics see the context-specific, no-easy-answer issue of sustainability as an ideal that can never be met, like World Peace. To that, Thompson and Sorvig provide a winning response: "The critics rightly remind us that there are

limits to what sustainability can or even should be. Yet within those limits, small efforts yield important results; local results in turn can contribute to cumulative global change" (2000, p3). It is to provide better tools to encourage those "local results" of sustainability that this thesis project was designed. It is true that some new sustainable development practices can be experimental, and that in time those experiments will prove themselves to be more or less sustainable. However, many tried-and-true methods of the pre-industrial past have already proven themselves to be practical and sustainable, and the lessons we have learned from a century's study of ecology have taught us to observe systems and processes that will lead us to more sustainable living. Ultimately, the most sustainable actions are those that keep exploring new ways to make the world a better place for humans and the natural resources we must protect.

Sustainable Design

What does it mean to design sustainably? It is important that professional designers interested in sustainability understand the various means they have to affect positive environmental changes. Mendler writes, "while environmental and economic sustainability is the goal, sustainable design is the means we as designers have to contribute to that goal" (2000, p2). ASLA's Environmental Sustainability policy statement reads, "Sustainability should be an integral part of the design process. The goals associated with creating a sustainable built environment include:

avoiding or otherwise minimizing the impacts on resources; conserving ecosystems (the source of all resources); using renewable resources; avoiding waste via re-use, recycling, and recovery; supporting the realization of human potential and happiness; and creating healthy built environments and landscapes for present and future generations. Communities should accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist. Designs should be of long-term value and should not burden future generations with intensive maintenance regimes. All products and processes should be evaluated and optimized for the full life cycle, thus minimizing waste and consumption. Sustainable design should meet the requirements of and respond directly to its context. Sustainable design should account for the following:

(1) Ecological: The natural forces that shape landscape, including climate, geology, hydrology, soils, elevation/landform, vegetation, wildlife and other living organisms.

(2) Socio/Cultural: The human forces that shape landscape including history, communities and customs, development patterns, agriculture, and social behavior and uses.

(3) Economic: The budget realities and cost-saving considerations that shape the built environment and the fiscal requirements necessary to support livable places and communities" (www.asla.org).

This begins to give professionals a sense of what is expected from them when they decide to approach design with sustainability in mind. The ASLA Environmental

Sustainability policy statement finishes with these suggestions: "Planners, designers and managers should share knowledge and encourage communication between colleagues, professionals from other disciplines, decision makers and community leaders, clients, developers, contractors, manufacturers and suppliers to:

(1) Enhance the understanding of and strengthen the integral relationship between natural processes and human activity and how sustainable design fits into everyday life.

(2) Improve practices, processes, procedures, products, and services that link long-term sustainable considerations and stewardship.

(3) Examine policies, regulations, and standards in industry and government to identify barriers to the implementation of the principles of sustainable design.

(4) Encourage community and business leaders to bring the existing built environment up to sustainable design standards and to reflect the philosophy of sustainability in the design and management of their communities" (www.asla.org). A policy statement is useful for providing a sense of what changes are *valued* in sustainable design; however, there are other resources that show more explicitly the kinds of changes that guide sustainable design.

Steiner has created a Sustainable Design Checklist that addresses a range of development approaches (See Figure 1-1).

TABLE 9.1
SUSTAINABLE DESIGN EVALUATION CHECKLIST

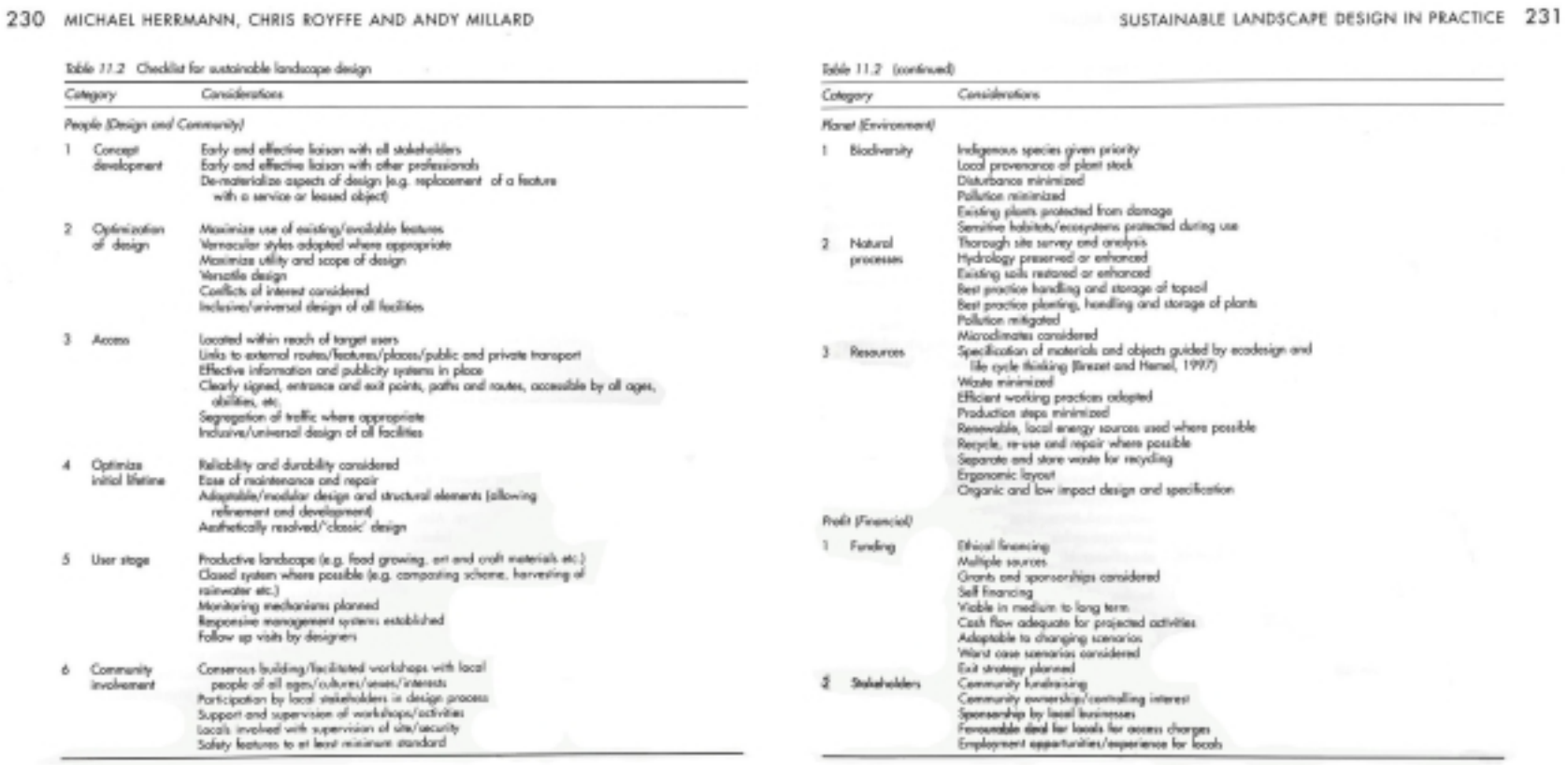
SUSTAINABLE	Completely	Partly	Neither	Partly	Completely	NOT SUSTAINABLE
Creates new permanent jobs						Reduces employment opportunities
Buildings and spaces are adaptable						Buildings and spaces are not adaptable
Provides educational opportunities						Reduced educational opportunities
Creates affordable human habitat						Destroys affordable human habitat
Reduces health risks						Increases health risks
Diminishes inequities						Increases inequities
Increases opportunities for social interaction						Reduces opportunities for social interaction
Enhances safety						Creates unsafe environments
Maximizes open space provision						Minimizes open space provision
Builds on local context						Disregards local context
Reduces stress (physical and psychological)						Increases stress
Beautiful						Destroys beauty
Diverse						Homogeneous
Remediates natural landscape						Degrades natural landscape
Creates purer air						Destroys pure air
Creates purer water						Destroys pure water
Uses rain water						Wastes rain water
Replenishes groundwater						Depletes groundwater
Produces its own food						Produces no food
Creates richer soil						Destroys rich soil
Uses solar energy						Wastes solar energy
Stores solar energy						Consumes fossil fuels
Creates silence						Destroys silence
Consumes its own wastes						Dumps waste unused
Maintains itself						Needs repair/cleaning
Matches nature's pace						Disregards nature's pace
Provides wildlife habitat						Destroys wildlife habitat
Moderates climate and weather						Intensifies climate
Increases use of renewable resources						Increases use of non-renewable resources
Uses local resources						Imports resources
Self-sufficient						Reliant on imports
Encourages walking/biking						Encourages automobile use
Encourages transit use						Encourages private automobile use
Reduces length of daily automobile trips						Increases length of daily automobile trips

SOURCE: Steiner et al. 1998, Pijanka et al. 2000.

Figure 1-1: Sustainable Design Evaluation Checklist. Steiner, 2000, p294.

This evaluation tool is structured as a continuum between Sustainable and Not Sustainable, with a range of levels, from "Completely," to "Partly," to "Neither." Under the "Sustainable" column, the design results include items such as, "Creates affordable human habitat;" "Builds on local context;" "Remediates natural landscape;" and "Replenishes groundwater." On the opposite side, under the "Not Sustainable" column, the opposite results are listed: "Destroys affordable human habitat;" "Disregards local context;" "Degrades natural landscape;" and "Depletes groundwater." The usefulness of this checklist is limited by the Not Sustainable column; the list of opposites does not engender a complete understanding of un-sustainable practices because it defines them as opposites. Nevertheless, Steiner's checklist shows successful ways to approach sustainable design from a larger-scale level of concern that addresses human and environmental needs for health, safety, and stability.

The British authors of *Landscape and Sustainability*, have created a landscape-specific Checklist for Sustainable Landscape Design (See Figure 1-2). This checklist is divided into three Categories: "People (Design and Community)," "Planet (Environment)," and "Profit (Financial)." Each Category has a numbered list of elements, and each element includes a list of Considerations. For example, under "People (Design and Community)," element 2 is "Optimization of design," and its considerations include, "Maximize use of existing/available features," "Vernacular styles adopted where appropriate," and "Inclusive/universal design of all facilities." Under "Planet (Environment)," element 2 is "Natural Processes," and includes considerations such as, "Hydrology preserved or enhanced," "Best practice planting, handling, and storage of plants," and "Microclimates considered." Finally, the Category of "Profit (Financial)," under element 1, "Funding," includes the considerations, "Ethical financing," and "Adaptable to changing scenarios," and under element 2, "Stakeholders," the considerations, "Community fundraising," and "Employment opportunities/experience for locals." Benson and Roe's checklist is created for landscape designers specifically, and its scope and scale are better suited for local landscape and planning design work. This checklist is perhaps more useful than Steiner's because of its organization and specificity. One useful aspect is the People, Planet, and Profit categories: these terms are easy to remember and serve as a good starting place for thinking sustainably.



230 MICHAEL HERRMANN, CHRIS ROYFFE AND ANDY MILLARD

Table 11.2 Checklist for sustainable landscape design

Category		Considerations
People (Design and Community)		
1	Concept development	Early and effective liaison with all stakeholders Early and effective liaison with other professionals De-materialize aspects of design (e.g. replacement of a feature with a service or leased object)
2	Optimization of design	Maximize use of existing/available features Vernacular styles adopted where appropriate Maximize utility and scope of design Versatile design Conflicts of interest considered Inclusive/universal design of all facilities
3	Access	Located within reach of target users Links to external routes/features/places/public and private transport Effective information and publicity systems in place Clearly signed, entrance and exit points, paths and routes, accessible by all ages, abilities, etc. Segregation of traffic where appropriate Inclusive/universal design of all facilities
4	Optimize initial lifetime	Reliability and durability considered Ease of maintenance and repair Adaptable/modular design and structural elements (allowing refinement and development) Aesthetically resolved/'classic' design
5	User stage	Productive landscape (e.g. food growing, art and craft materials etc.) Closed system where possible (e.g. composting scheme, harvesting of rainwater etc.) Monitoring mechanisms planned Responsive management systems established Follow up visits by designers
6	Community involvement	Consensus building/facilitated workshops with local people of all ages/cultures/sexes/interests Participation by local stakeholders in design process Support and supervision of workshops/activities Locals involved with supervision of site/security Safety features to at least minimum standard

SUSTAINABLE LANDSCAPE DESIGN IN PRACTICE 231

Table 11.2 (continued)

Category		Considerations
Planet (Environment)		
1	Biodiversity	Indigenous species given priority Local provenance of plant stock Disturbance minimized Pollution minimized Existing plants protected from damage Sensitive habitats/ecosystems protected during use
2	Natural processes	Thorough site survey and analysis Hydrology preserved or enhanced Existing soils restored or enhanced Best practice handling and storage of topsoil Best practice planting, handling and storage of plants Pollution mitigated Microclimates considered
3	Resources	Specification of materials and objects guided by ecodesign and life cycle thinking (Bringezu and Hamel, 1997) Waste minimized Efficient working practices adopted Production steps minimized Renewable, local energy sources used where possible Recycle, re-use and repair where possible Separate and store waste for recycling Ergonomic layout Organic and low impact design and specification
Profit (Financial)		
1	Funding	Ethical financing Multiple sources Grants and sponsorships considered Self financing Viable in medium to long term Cash flow adequate for projected activities Adaptable to changing scenarios Worst case scenarios considered Exit strategy planned
2	Stakeholders	Community fundraising Community ownership/controlling interest Sponsorship by local businesses Favourable deal for locals for access charges Employment opportunities/experience for locals

Figure 1-2**:** Checklist for Sustainable Landscape Design, Benson and Roe, 2000, p230-231.

While all three categories and their elements may overlap and need to be revised or enhanced depending on location and issues of concern, the checklist is a practical prototype for guiding sustainable design in the landscape.

Again, sustainable design, as Mendler notes, is the means that design professionals have to contribute to sustainable goals. The concept of sustainability and the guidance of sustainable design checklists like those shown here can assist designers at every level of expertise in creating projects that make a difference in people's lives, improve the life of the natural environment, and bring to life local economies with ethical profits from actions that promote long-term health and well-being.

Chapter Two: Land Development Regulation

Land Use Planning

"Willful are the ways of the Countryside, and enthusiastic the eruptions of unsupervised greenery. Establish at the outset a systematic programme of vegetation control. Those minor floral disobediences may be dealt with easily…but the higher greeneries will require a more sophisticated approach."

From ***Legal Daisy Spacing: The Build-A-Planet Manual of Official World Improvements****, by Christopher Winn*

Land use planning has a long history in the United States, rooted in the enduring tension between private property rights established in the Bill of Rights and the police power granted to the states and their political subdivisions by the Tenth Amendment of the Constitution. The first comprehensive zoning ordinance in New York City in 1916 established a trend toward regional and local land use control that seeks to balance private property rights with public health, safety, and welfare rights. While most land use and zoning decisions are made at the regional/local level, environmental regulation has traditionally been handled at the federal and state levels. The primary reason for this is that environmental issues do not respect political boundaries; water pollution from industry in Atlanta, Georgia, can affect water quality in Florida's Apalachicola Bay—over 400 miles away. Another reason for this has been a lack of environmental expertise at the local level, although this seems to be changing; Alachua County led the state of Florida with its requirement for double-walled underground fuel-storage tanks in 1986, which led to the State Underground Petroleum Environmental Response Act. Regional and local decisions about land use and development may not address

environmental issues (1) because land use decisions have generally been incremental—gradually resulting in severe environmental impacts, and (2) because of the influence of money and power at the local level and the reality these play in decision-making. This, too, is changing; it is increasingly clear that local legislation that supports environmental regulation is vital for enhancing and ensuring regional and statewide initiatives—so state and regional lawmakers are learning to harness that local support.

Growth and Land Development in Florida

Land development in Florida is growing rapidly, due largely to a growing population. The current annual rate of population growth in Florida is 2.6%, which will double the current population in less than 30 years. Some projections indicate that the state will grow from more than 16 million people to more than 33 million people by the year 2030. Needless to say, planners and policy-makers all over the state are trying to find ways to anticipate and accommodate this rapid growth without sacrificing the environmental integrity, economic viability, and quality of life for all of Florida's inhabitants.

Since the late 1960s, planners all over the United States have recognized that solutions to urban growth and land use problems lie in careful growth management planning. Growth management is most simply defined as "the regulation of the *amount*, *timing*, *location*, and *character* of development" (Levy, 2003, p226). A growth management system is different from a comprehensive plan—although a growth management system

might include a comprehensive plan—and generally includes zoning and land development regulations. Growth management plans require long-term coordination between land-use controls and public capital investment, on local, regional, and state-wide scales to be effective.

Florida is one of only ten states in the nation to create a comprehensive state planning program aimed at managing growth, and was one of the first states to do so (Mattson, 2002, p15). The Environmental Land and Water Management Act, which passed in 1972 after extensive lobbying from environmental groups, had three main policy objectives: (1) protecting Florida's natural environment; (2) containing the cost of municipal service delivery (infrastructure) that resulted from increasing urban sprawl; and (3) maintaining the state's level of economic growth without sacrificing the first two objectives (Mattson, 2002, p13). The 1972 Act stated that in "areas of critical state concern" and "developments of regional impact" the state could overrule a local land use decision if it did not take into account effects that might extend beyond the boundaries of the locality (Levy, 2003, p237). An area of critical concern is defined as "(1) an area containing, or having significant impact upon, environmental, historical, natural, or archeological resources of statewide importance; (2) an area significantly affected by, or having significant effect upon, an existing or proposed major public facility or other area of major public investment; (3) a proposed area of major development potential, which may include a proposed site of a new community, designated in a state land development plan" (Levy, 2003, p238). A "development of regional impact," is defined as a project that "'because of its character,

magnitude, or location, would have a substantial effect on the health, safety, or welfare of the citizens of more than one county.'" For example, "a regional shopping center that would affect the pattern of vehicular traffic in adjacent counties could be classified as being of regional impact," as well as a power plant whose emissions might affect air quality in adjacent counties (Levy, 2003, p238). This first foray into top-down state-sponsored growth management compelled city and county land use planning to be more accountable to the state government.

After a decade under the 1972 act, the legislature determined that the original plan needed a revision. The next major piece of legislation was the Growth Management Act of 1985, which was widely praised at the time for the innovative approach of its regional planning component. The 1985 Act added another level of growth control through "concurrency requirements," which compel local governments to demonstrate that the level of infrastructure required for a new development is already in place *before* that new development can be built (Levy, 2003, p238). For example, water and sewer systems would need to be in place before a developer could get approval to build a new housing subdivision, and it would be necessary to show that the road capacity already existed for increased traffic flow (Levy, 2003, p238).

The 1985 Growth Management Act also organized the state into eleven Regional Planning Councils whose responsibility it is to prepare and adopt regional plans that are in keeping with the state comprehensive plan. The Local Government Comprehensive Planning and Land Development Regulation Act, which was meant to guide

future growth and development at a local level, was also adopted as part of the 1985 Act. Local comprehensive plans address issues related to future land use, housing, transportation, infrastructure, coastal management, conservation, recreation and open space, intragovernmental coordination, capital improvements, and, of course, urban sprawl. The state Department of Community Affairs (DCA) is responsible for reviewing local comprehensive plans and plan amendments for the 408 municipalities and 67 counties in Florida; other review agencies are the Regional Planning Councils, the Water Management Districts (WMDs), the Florida Department of Transportation (FDOT), the Department of Environmental Protection (DEP), the State Department, the Department of Agriculture, and the Florida Fish and Wildlife Conservation Commission (FFWCC). These agencies also review plans and plan amendments and issue recommendations and objections to the DCA. A growth management system with a strong regional component and an extensive method of plan review seems well organized for the task of guiding future land development. On the surface it would appear that Florida's growth management system is well conceived and sure to be effective; however, sprawl appears to continue unabated and there is widespread disillusionment with the Florida system. Among its harshest criticisms is its failure to address the need for new school facilities as part of concurrence, and most importantly, its failure to find a link between growth management and water resource management. The 1985 Growth Management Act does not acknowledge the potential for water as a limiting

factor in the state. Concerns for water resources in Florida are further addressed in Chapter Three.

Local Tools for Community Sustainability: Landscape Ordinances

There are many ways for a local comprehensive plan to enhance and reinforce state laws while also tailoring requirements to each region's specific needs and concerns. According to Steiner, there are four general kinds of authority that local governments can use to implement landscape plans: "the power to *regulate*, the power to *condemn* and *exact*, the power to *spend*, and the power to *tax*. *Regulation* derives from the police powers to protect public health, safety, welfare, and morals. The most common…regulatory technique used in the United States is zoning. Other techniques, which may be used in conjunction with zoning, include planned unit developments (PUDs), performance standards, design guidelines, critical (or environmentally sensitive) areas protection, wetland and riparian area protection, habitat conservation plans, historic preservation, subdivision regulations, and building codes. Covenants are private contracts that can be used to regulate many of the same features as zoning, design guidelines, and subdivision ordinances" (Steiner, 2000, p329-330). Regulations that apply to all aspects of land development usually fall within the general category of "land development regulations," also know as LDRs.

Land development regulations in Florida, according to the definition used in the state's Local Government Comprehensive Planning and Land Development Regulation

Act, are "ordinances enacted by governing bodies for the regulation of any aspect of development and includes any local government zoning, rezoning, subdivision, building construction, or sign regulations, or any other regulations controlling the development of land" (Florida Statutes, Title XI, Ch. 163, Section 163.3164, www.flsenate.gov/statutes). LDRs address everything from land use decisions mapped out for each city, to building height restrictions, to roadway widths and parking space provisions.

Landscape ordinances are usually found within LDRs, but depending on the municipality, the requirements may or may not be codified separately and entitled as such. Either way, a landscape ordinance is "a public law, requiring public review and approval of a permit….that regulates landscape design, landscaping, and landscape installation and maintenance" (Abbey, 1998, p414). According to Abbey, whose book, *U.S. Landscape Ordinances: An Annotated Reference*, is the most complete study of landscape codes and standards across the United States, a "greenlaw" is a general category of codes and ordinances that addresses requirements for vegetation and green spaces in urban areas. Landscape ordinances and other "greenlaws" act as problem-solvers for issues related to community design, like site clear-cutting, tree preservation, on-site stormwater management, and the urban heat island effect. According to Abbey, the most common reasons that landscape codes are created are: to protect the view of public right-of-way, to resolve parking lot issues, and to buffer adjacent land uses. Although these are the typical reasons for enacting "greenlaws," landscape ordinances are being recognized for their potential to do much more.

Landscape ordinances are also the perfect vehicle for addressing sustainable site development practices at the local level. The Sustainable Design Evaluation Checklist developed by Steiner and the Checklist for Sustainable Landscape Design by Benson and Roe (Figures 1-1 and 1-2) in Chapter One were created to show how sustainability can guide local decision-making and local choices in development. Likewise, "greenlaws" and landscape ordinances that incorporate sustainable measures can encourage resource conservation by engaging community support for land development practices that protect the natural environment, discourage sprawl, and boost the local economy. Landscape ordinances can and should be thought of as local land use controls that regulate land development decisions for the long-term sustainability of a community.

Landscape ordinances, because they are *local* rules and regulations, differ from state and federal regulations in that they usually have community support in addition to local government support for their adoption. The public support aspect of landscape ordinances and other local codes that affect people's everyday lives cannot be overstated. Arendt writes, "The future that faces most communities that have adopted standard land-use regulations is to witness the systematic conversion of every acre of buildable land into a developed use. As long as such standard regulations remain on the books, the future will inevitably consist of one development after another, each consisting entirely of house lots and streets. However, for those who desire a future comprising something more than lawns and cul-de-sacs and who would like to see substantial acreages of open space

conserved each time a tract is subdivided, real practical alternatives do exist" (Arendt, 1999, p7-8). Arendt's design strategies for the book *Growing Greener: Putting Conservation into Local Plans and Ordinances* are directed at city officials and community leaders; these are the people who can, and often do, make local sustainable development happen. Local leaders are recognizing the need for community support, and landscape ordinances are becoming increasingly popular as a way to express a community's ideals. There are many tools available for city officials and community leaders to educate themselves and their constituents about "greenlaws" and landscape ordinances and how they can be used. Model landscape ordinances, written by regional and local governments, industry organizations, and non-profit groups, can be adapted for any community's needs.

Emerging Greenlaw Issues

Recently written landscape ordinances address issues that Abbey refers to as "cutting edge elements of landscape codes," or "emerging greenlaw issues." These issues include land clearing controls; habitat preservation and tree protection; green parking lot design; Xeriscape™ practices and water conservation methods; low-impact development (LID) strategies for stormwater management; tree "banking;" and native tree replacement. (Examples of model water-conserving landscape ordinances, including the five ordinances analyzed for this project, will be discussed in Chapter Five.) While the content of landscape ordinances is changing to embrace more sustainable practices, this is no hindrance to revision and adoption. The typical structure of a landscape ordinance is

flexible, and this open organization allows for many ways of designing a community's "green" laws.

Typical Structure of a Landscape Ordinance

The typical structure of a landscape ordinance addresses the following issues: the purpose of the code; the definitions of terms used within the code; the applicability; the specifics of the landscape design requirements; the submittal requirements and approval processes; the enforcement rules; the maintenance requirements; and any other necessary information, like plant lists; sometimes alternative methods of compliance are included. Every landscape code is written specifically for each city or county, and thus, no two are alike. Even the placement of a landscape code within the organization of local land development regulations varies. The Louisiana State University School of Landscape Architecture has undertaken an ongoing Landscape Ordinance Research Project, along with professor/author Buck Abbey, ASLA. The following Model Landscape Code Outline is excerpted from the research project website, and is the best available overview of the typical structure of existing landscape codes.

Model Landscape Ordinance Outline

www.greenlaws.lsu.edu/lsumodel.htm

Section 1-Short Title

This section of the ordinance identifies the law and places it in context of some other community code. Most landscape ordinances are contained within zoning ordinances, subdivision regulations or general municipal codes of regulations.

Section 2-Purpose, Intent, and Definitions

This section declares the purpose and intent of the ordinance and how it has a bearing on the health, safety, and welfare of the community. Definitions are given to clarify the

meaning of certain terms and technical language contained within the law.

Section 3-Applicability of Landscape Ordinance

This section describes how the law applies in the community. Generally, landscape ordinances apply to specific zoning districts within the community's Zoning Ordinance. For example, in some communities the landscape ordinance applies only to commercial districts while in others they apply to all, from residential to industrial.

Section 4-Land Clearing and Modification

It is the intent of this section to protect the natural resources of the community by requiring that a building permit and land clearing permit be acquired prior to the start of construction or modification to land areas.

Section 5-Site and Landscape Design Standards

Within this section of the ordinance are minimum site design and landscape design standards that the community feel are important to protect the public health, safety, and welfare of the community. Typical standards address plant and unique natural resource preservation, landscape zone dimensions, plant installation standards and requirements, storm water retention and recharge, irrigation, air cleansing, site distances, maintenance, plant material standards, recommended plant species.

Section 6-Landscape Maintenance

Maintenance is an important concern to all living things, particularly plant materials in their first year of establishment. To ensure that newly planted vegetation survives and serves the purpose of the ordinance and to be neat, healthy, and orderly, it is the intent of this section of the ordinance to specify certain minimum maintenance standards of watering, pruning, fertilizing, and plant care. In some instances communities require the posting of bonds to insure the survival of the plant material.

Section 7-Landscape Plan Required

This section describes the preparation of the landscape plan which is used by the community to evaluate compliance with the terms of the landscape ordinance. Language within this section describes what is to be shown on the plan, what dimensions, quantities, and calculations are required, and the drawing standards and conventions so that drawings can be read with clarity. Often this section requires that the person preparing the plan be trained in a professional engineering, architecture, or landscape architecture course and be licensed in conformance with appropriate state law and insured for public liability protection.

Section 8-Alternative Compliance and Landscape Credit

Alternative compliance refers to betterment of the requirements of this ordinance. In addition, because all sites are different there needs to be a procedure for encouraging innovative, unique, and site specific landscape design that

exceeds these minimum requirements. Alternative compliance will provide a mechanism to exceed these minimum standards, develop a point standard system, and set minimum qualifications of the person designing the landscape plan.

Section 9-Permit Application Procedures

This section of the ordinance describes the procedure for seeking the required permit, payment of fees, and public review policy.

Section 10-Enforcement, Penalties and Appeals

It is the purpose of this section of the ordinance to describe the enforcement procedures to be followed to insure compliance with the provisions of the law. Penalties for violations of the law and a procedure for appeals for any aggrieved party seeking redress are given. The community generally designates enforcement official and offices having jurisdiction.

Section 11-Administrative Guidelines

Each community will have special administrative procedures that it will follow to help the public interpret the ordinance. Administrative guidelines can be devised to assist with the administration of this ordinance.

Section 12-Conflicts

This section of the ordinance addresses conflicts between this ordinance and other ordinances within the community.

Section 13-Severability

Severability provisions are usually included to sever and remove any part of the ordinance that may prove to be unconstitutional or in conflict or violation of other applicable laws.

Section 14-Effective Date

This is the date that the law goes into effect.

Typical Landscape Design Standards

Since a landscape ordinance must provide complete and detailed instructions for its requirements and procedures, the content can be designed according to each community's particular needs. The "Site and Landscape Design Standards" section is usually the most important for landscape architects and landscape designers. The Landscape Design Standards section of a landscape ordinance, as Abbey summarizes in Section 5, "Site and Landscape Design Standards," above, may

address a range of requirements, such as plant and unique natural resource preservation, landscape zone dimensions, plant installation standards and requirements, storm water retention and recharge, irrigation, air cleansing, site distances, maintenance, plant material standards, and recommended plant species. This section usually guides the designer's landscape planning decisions by requiring creativity to ensure that design solutions are in compliance. The following excerpt from the Homestead, Florida, Landscape Ordinance shows an example of the language used and detail included in typical landscape design standards:

"Sec. 29-5. Tree removal and preservation.

Tree removal permits or natural forest community vegetation removal permits are required prior to the removal of trees, specimen trees, or any vegetation in a natural forest community, respectively, pursuant to Section 29-60 of the City of Homestead. The Development Services Department is responsible for administering and enforcing these provisions.

Sec. 29-6. Minimum standards.

The following standards shall be considered minimum requirements unless otherwise indicated:

(a) Lawn area (turf).

(1) Lawn areas shall be planted with species well adapted to localized growing conditions in Homestead. Lawn areas may be sodded, plugged, sprigged, hydromulched, or seeded except that solid sod shall be used in swales or other areas subject to erosion. In areas where other than solid sod or grass seed is used, overseeding shall be sown for immediate effect and protection until coverage is otherwise achieved"

(Homestead Landscape Ordinance, 7/3/01, p11).

These are general statements of expectations, and further details usually follow, unless the reader is directed to another source, as in Section 29-5, Tree removal, above. In Section 29-6, Lawn area (turf), parts (a) and (1) are followed by increasingly more detailed requirements, such as:

"The maximum amount of lawn area for residential and mixed uses shall be limited to a maximum of sixty (60) percent of the required landscaped open space. In those residential and mixed use zoning districts where landscaped open space is not specified, lawn areas shall be restricted to a maximum twenty (20) percent of the net lot area less than the area covered by buildings. Very drought tolerant grasses and low growing native and/or drought tolerant plant species, including grasses and forbs, as referenced in the Landscape Manual, may be used as groundcover beyond the maximum permitted grass area" (Homestead Landscape Ordinance, 7/3/01, p11).

Landscape design standards can require almost anything a community agrees upon, but no matter the content, the standards are expected to be clearly written and their requirements and prohibitions explicitly stated. After all, landscape ordinances and "greenlaws" are intended to be progressive and effective regulations that enhance a community's value, not more bureaucratic red tape. When significant changes are proposed to local ordinances, community support can make the difference between regulations being regarded as forward-thinking, economically beneficial, and sustainable, instead of a regulatory headache.

Regulations, Applicability, and Incentives

Regulations are applicable for all new development projects and redevelopment projects, usually above specified area or expenditure thresholds, but there are exceptions. All bonafide agricultural activities are exempt from landscape ordinance regulations, as are single family homes that are not within designated subdivisions. Other exemptions are golf courses and athletic fields, and sometimes public rights-of-way. Most everything else—all newly developed land projects and most redevelopment projects that are built after the date of the landscape ordinance adoption—must follow the rules and standards.

One of the difficulties in creating land development regulations, landscape ordinances, and local codes of any kind, is the way that these rules are regarded by the professionals who must follow them. There is, among some professionals in building and development careers, the perception that there can be "too much" of a good thing—and some might argue whether regulations are a good thing in the first place. The fact is that the business of land development is a "big business" in Florida and all over the United States. From the housing boom after World War II to the present, populations rise and fall, standards of living increase and decrease, and land development keeps up with the pace. An equally important fact is that fulfilling the requirements of regulations may, in some cases, take money and/or time for compliance. Therefore, some regulations come with additional incentives. Minimum standards in regulations are required and will be enforced, but when government planners and local

leaders want to encourage developers to meet requirements at higher levels—to encourage sustainable practices above and beyond the minimum levels required for health, safety, and welfare—they create incentives to make it worth the additional time and money spent. Local governments should consider what incentives are appropriate and meaningful to their constituents; some of the most commonly used incentives are: reductions for city or county permit application fees; reductions for stormwater utility charges; reductions in building permit fees; or property tax reductions. Often regulations state that any developer of an exempted project type, or any exempted single-family homeowner, who wishes to benefit from the incentives may voluntarily meet the higher standards and receive the reduced fees. There may also be incentives for voluntary compliance that include public recognition programs sponsored by the local government; this is especially true of "green" building programs and sustainable projects, as these issues are becoming important to an increasingly educated public. All of these incentives, and more innovations for encouragement, will ultimately make sustainable landscape ordinances powerful tools for community sustainability.

Chapter Three: Water Conservation in Florida

Florida's Water Problems

"I have no real doubts myself, mind you, but to many others in the world, especially the Florida world, to question the complete goodness of population growth is a perverse and sinister sort of iconoclasm that probably should be investigated by a committee."

From "A Dubious Future," ***A Naturalist in Florida****, by Archie Carr*

Florida boasts 1,197 miles of coastline, 7,700 lakes greater than 10 acres, more than 1,700 streams, 3 million acres of wetlands, and 27 first-magnitude springs; the state is a peninsula, surrounded by the Atlantic Ocean on the east and the Gulf of Mexico on the west; Florida has one of the highest average annual rainfall amounts of any state in the country, with an average of 54 inches annually—so why does Florida (a land mass literally floating on water) have "water problems"?

The fundamental water problem is that freshwater is a limited resource. Most of the available freshwater on Earth is either frozen or underground, and the volume available for human use varies over time. The demand for freshwater will continue to increase despite the fact that availability continues to fluctuate. There are five reasons underlying Florida's particular water problems:

- The recharging of groundwater varies naturally since it is replenished by varying amounts of precipitation;
- Population growth/tourism pressure means increasing demand for freshwater;
- Stormwater runoff practices in developed areas have traditionally not followed natural hydrology, further

decreasing the amount of precipitation available to recharge the groundwater;

- Water quality problems from pollution can threaten freshwater availability; and
- The natural hydrology of the state, primarily in the south, was altered some time ago, and efforts are still underway to repair the damage.

The main source of all freshwater in Florida is precipitation, which is stored in surface water bodies and contained in groundwater reservoirs, or aquifers. While the average rainfall per year in Florida is 54 inches, that precipitation is unevenly distributed throughout the state; from 1951 to 1980, the average annual precipitation ranged from more than 64 inches in the panhandle (northwest) of the state to less than 48 inches near Tampa Bay (Randazzo & Jones, 1997, p69). Much of the precipitation that falls is returned to the atmosphere through evapotranspiration, but the rest infiltrates and percolates down to the water table to recharge the groundwater or is collected by surface water features and flows into the sea. However, recharge rates, like precipitation amounts, are not distributed evenly; annual recharge rates can range from near zero in some lowland areas to greater than 20 inches per year in well-drained upland areas (Fernald & Purdum, 1998, p38). The precipitation that makes its way into the groundwater reservoirs, or aquifer systems, is the main source of freshwater for public supply. Nearly 93% of Florida's population depends on groundwater for drinking water. In 1995, the state ranked fifth in the nation for use of freshwater for public drinking supply, and of the total freshwater used that year, 60% was groundwater (Fernald & Purdum, 1998, p38).

Florida's growing population is creating a greater demand for public water supply than ever before; it continues to rank as one of the fastest growing states in the nation. Population growth depends on two components: natural increase (more births than deaths), and more immigration than emigration (domestic and international). During the 1990s, Florida's population rose by 3 million people. The natural increase in Florida's population was 14.7%, and migration accounted for 85.3% of the increase. In 2004, Florida's population was estimated to be 17.5 million—a 9.6% increase over a four-year period since the 2000 census (www.state.fl.us/edr/population/popsummary). Additionally, tourism brings 40 million people to Florida annually, which means that the pressure on water resources is increased by visitors. Ironically, the state's main attractions, its miles of coastlines, rivers, wetlands, and springs, are some of the most sensitive environments in the United States—nine out of the twenty-one most threatened ecosystems in the country are in Florida (Fernald & Purdum, 1998, p11).

Stormwater management systems have traditionally been designed to whisk away water to make the maximum amount of land developable. Consequently, water that would have been available for use by Florida's ecosystems and/or for human use is sent out to sea or "lost" through evaporation and runoff. Polluted stormwater runoff is also a significant cause of pollution in groundwater and surface water alike.

Water quality degradation in Florida's lake, rivers, and estuaries has occurred as a consequence of polluted stormwater runoff from agricultural and urbanized areas. Because of regulatory controls, point source pollution appears

to be diminishing, but nonpoint source pollution still accounts for significant water quality problems. Nonpoint source pollutants come from many sources, as the name suggests, and include stormwater runoff, septic tanks, erosion from construction sites, unpaved roads and farm fields. Wastewater can also be a toxic source of pollution, although improved treatment technologies and increased regulation and enforcement are having positive effects.

The state has been altered hydrologically and ecologically since the 1800s. Lands in the south and southwest were drained for agriculture, industrial and residential development; the Kissimmee River was straightened; and the Cross-Florida Barge Canal was begun to create miles of dikes and canals in an effort to bisect the middle of the state. The effects of agricultural activities, such as sugarcane farming, have contributed to the severe degradation of the Everglades; only 50% of the historic Everglades remains intact. In 1995, the state passed the Everglades Forever Act, which was followed by the federally- and state-funded Comprehensive Everglades Restoration Plan, or C.E.R.P., approved by the Water Resources Development Act of 2000; these scientists and planners have the arduous and important task of restoring this sensitive ecosystem's damaged hydrology throughout the coming decades.

A Brief Lesson in Florida Hydrology

There are three aquifer systems in Florida that are used for water supply: the surficial aquifer system, the intermediate aquifer system, and the Floridan aquifer system. (See Figure 3-

1.) An aquifer system consists of two or more hydraulically connected aquifers. (Fernald & Purdum, 1998, p38).

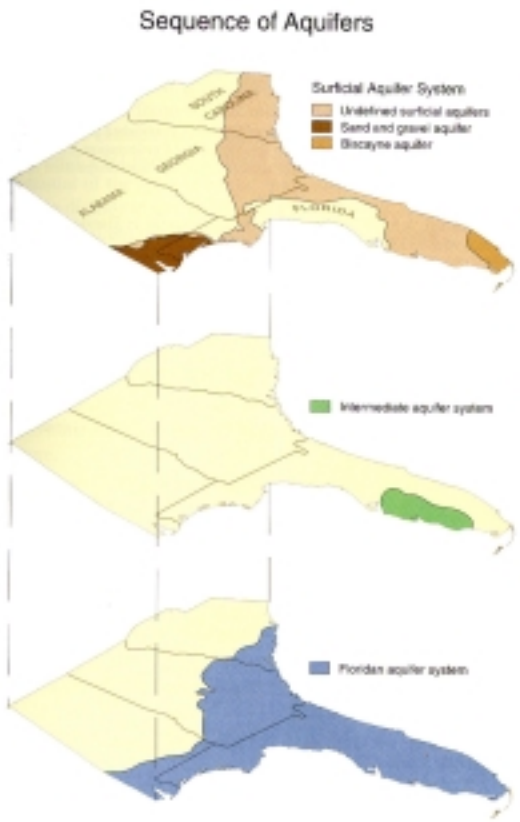


Figure 3-1: Sequence of Florida Aquifers. Fernald & Purdum, 1998, p38.

The surficial aquifer system is used by a few municipalities and individual households. The system is divided into three major aquifer areas: the undefined surficial aquifers, the sand and gravel aquifer, and the Biscayne aquifer. The sand and gravel aquifer is the major source of water in the northwest of the state, while the Biscayne is the major source of water for the southeastern part of the state. The intermediate aquifer system, which lies between the surficial and the Floridan, supplies the areas of Sarasota, Charlotte, and Glades counties. The Floridan aquifer system underlies the entire state and even stretches into portions of Alabama, Georgia, and South Carolina. This system provides water for many cities like Gainesville, Jacksonville, Tallahassee, Ocala, Orlando, and St. Petersburg. The Floridan

is also heavily pumped for agricultural and industrial water supply.

Florida's subsurface limestone, a porous rock type, is what creates the aquifer system; rainwater, which is somewhat acidic as it falls from the sky, soaks into the earth, picking up decomposed matter that increases its acidity, and when it reaches the alkaline limestone (down some 3,000 feet or more), it eats into it and continues to percolates down, creating and enlarging spaces where water is held. According to Fernald and Purdum, hydrologists have estimated the total quantity of fresh groundwater in Florida is "more than a quadrillion gallons—about one-fifth as much as in all of the five Great Lakes, 100 times that in Lake Mead on the Colorado River, and 30,000 times the daily flow to the sea of Florida's 13 major coastal rivers" (1998, p38).

Floridians pump billions of gallons of water from the aquifer daily, and the groundwater recharge cannot always keep up with this demand. Overpumping not only threatens the potable water supply, but it can also create other problems, like sinkhole formations, wetland drawdowns (lowered water levels), and even saltwater intrusion into areas where freshwater has been pumped away. Water needs are expected to increase in the future because of population growth, increased tourism, and greater agricultural/industrial demands. Monitoring and conserving water in Florida are vital to long-term protection of the state's most valuable natural resource. Since the 1960s, concerned Floridians have proposed and passed environmental legislation to protect these valuable water resources.

History of Water Regulations in Florida

There have been hundreds of state laws and regulations on water resources enacted in Florida. During the 1800s, lands in areas of the south and southwest were drained to facilitate navigation and make room for agricultural and residential development, as mentioned previously. These early misguided hydrological alterations, and others, are still affecting the state today. Since Florida enacted the Environmental Land and Water Management Act in 1972, efforts have doubled and redoubled to find solutions to Florida's water problems. The Water Resources Act (Chapter 373, Florida Statutes), which was created as part of the Environmental Land and Water Management Act in 1972, was recognized by the National Water Commission as a model water statute, particularly because of its innovation in establishing regional oversight—the five Water Management Districts (WMDs)—but also for establishing the need for a comprehensive state water plan (Fernald & Purdum, 1998, p13). The Water Resources Act provided a two-tiered administrative structure headed at the state level by the Department of Natural Resources (now the Department of Environmental Protection, or DEP) and at the regional level by five Water Management Districts. (See Figure 3-2.) The law also required each WMD to formulate a water shortage plan and to establish minimum flows and levels for surface waters and minimum levels for groundwater. Since then, the WMDs have provided increasingly effective management and regional oversight for their districts, each of which is defined by watershed basins rather than political boundaries.

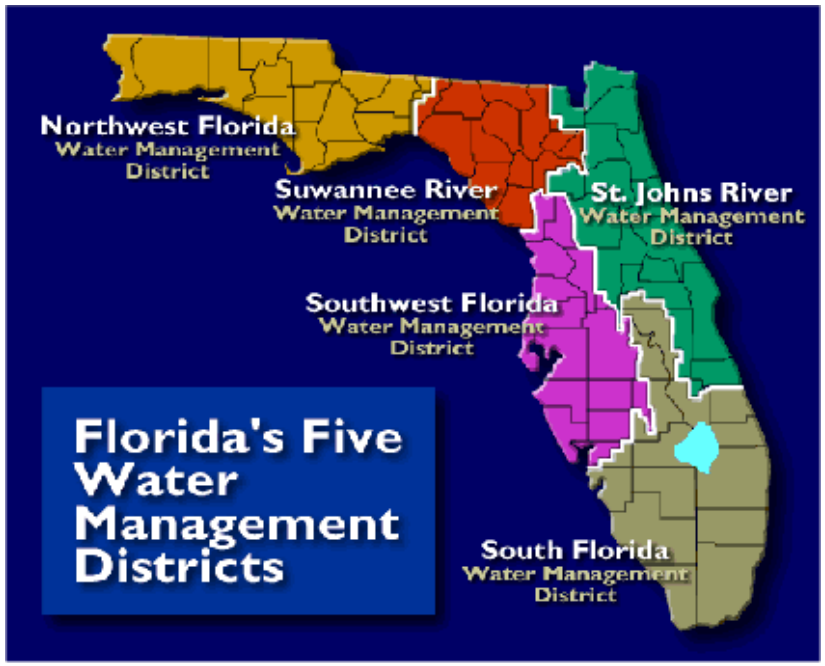


Figure 3-2. From www.sfwmd.gov/histo/3_5wmd_map.

In the 1970s and 1980s, the protection of groundwater became a major issue in Florida, since it is the primary source of drinking water in the state. The Task Force on Water Issues, which was appointed by the Speaker of the House of Representatives in 1983, reported that "the threat of contamination of groundwater and related surface waters from hazardous wastes, sewage, industrial wastes, and pesticides was 'the most significant water problem facing Florida,'" and in response, the legislature passed the Water Quality Assurance Act of 1983, which levied taxes on pollutants entering the state and improved the DER, (now DEP)'s ability to protect groundwater and contaminated resources. It was divided into twelve separate parts, each of which addressed a distinct groundwater or hazardous waste problem. The Act also recognized the need for compiling water resource data. The State Underground Petroleum Environmental Response Act of 1986 further addressed the need for preventing pollution from leaking underground storage tanks, and for funding cleanup of existing pollution

sites (Carriker, 2001, p5). In 1987, the Surface Water Improvement and Management Act (SWIM) initiated the first statewide program "for protecting or restoring priority surface water bodies of regional or statewide significance" (Fernald & Purdum, 1998, p164). The Florida Environmental Reorganization Act in 1993 merged the Department of Natural Resources with the Department of Environmental Regulation to form the Department of Environmental Protection (DEP). Soon thereafter, the DEP and the WMDs together began a coordinated statewide water resource planning initiative, which resulted in the comprehensive District Water Management Plans (DWMPs) in 1994. These DWMPs provided comprehensive regional assessments of water resources for the first time. The DEP adopted the Florida Water Plan in 1995, which built on the district plans with a statewide intergovernmental perspective on priority water issues. Since then, the state has continued to keep water resource conservation a priority by enacting laws like the local Xeriscape ordinance legislation in 2001, and the Water Conservation Initiative in 2002.

Water Use in Florida

"Consumptive use" is that part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. [It is] sometimes called water consumed or water depleted" (USGS Water Use Trends FL, 2000, p.vi). Consumptive water use is permitted in the state of Florida by the five Water

Management Districts according to six classifications agreed upon by the WMDs and the DEP:

Public Supply: water withdrawn by public or private water suppliers and delivered to users who do not supply their own water; this includes domestic (residential) uses, but also commercial, industrial, power-generating, and public-water uses;

Recreational/Aesthetic: originally part of Agricultural category from 1965-1984, and 1986-1989; water uses for maintaining vegetative growth in recreational lands, parks, and golf courses—primarily for the irrigation of turfgrass;

Agricultural: water use for agricultural irrigation of crops, plants, or pasture, and nonirrigation purposes, such as uses for livestock, fish farming, and other farm needs;

Industrial or Commercial: uses for industrial purposes, such as fabricating, processing, washing, and cooling, including such industries as steel, chemical and allied products, paper and allied products, mining and petroleum refining; and uses for commercial purposes, such as for motels, hotels, restaurants, office buildings, commercial facilities and civilian and military institutions;

Mining or Dewatering: uses for the extraction of minerals and liquids, including milling, environmental purposes, material conveyance; and dewatering, which is a deliberate attempt to lower the groundwater level in or below land surface for agricultural, construction, mining or other purposes—this usually means pumping the water out of the ground and discharging to a surface water body; and

Standby Alternative Source, or **Self-Supplied**: water withdrawn from a ground or surface water source by a user and not obtained from a public supply; this includes wells (USGS Water Use Trends FL, 2000, Glossary p.vi-x). These six categories classify water withdrawals according to source, use, and method of withdrawals.

Florida's total water withdrawals in 2000 were 20,146.41 million gallons per day. Of that state total, 11,954.64 mgd was saline withdrawal, and 8,191.77 mgd was freshwater withdrawal. Of the freshwater withdrawal, 5,078.67 mgd was groundwater, and 3,113.10 mgd was fresh surface water. (All 11,954.64 mgd of the saline withdrawal was used for thermoelectric power.) Public Supply water use (all of which was freshwater) comprised 2,436.79 mgd, or 2,436,790 gallons per day. The Southwest Florida Water Management District (SWFWMD) and other sources estimate that as much as 30% to 50% of public supply is used for landscape purposes (Foley, 1999, p15). Using the lower end of that estimate, 30% of Florida's public supply water use in 2000 would be approximately .73 mgd—nearly three-quarters of a million gallons per day.

Landscape Irrigation, Water Supply, & Sustainability

Water used for landscape irrigation generally comprises more than one quarter of total residential water demand. Bond writes, "Within a typical landscape, turf, usually St. Augustine grass, is predominant, covering up to 80% or more of the land surface and requiring up to a 1-inch depth of water per week. Concrete driveways or sidewalks

cover most of the remaining area. Ornamental flowerbeds, trees, and rock gardens may be present to a limited extent. Underlying the landscape may be fill material, which may or may not be conducive to healthy plant growth. An in-ground irrigation system may be operated long enough to provide sufficient water to the driest areas of the landscape, thereby over watering the remaining areas. Significant non-irrigable areas (i.e. streets, driveways, and sidewalks) may be receiving water" (1999, p32). This paints a picture of a typical residential site where water conservation in landscape irrigation is not usually a consideration.

Is water use for irrigation sustainable at all? Thompson and Sorvig weigh in on this question: "Irrigation means the addition of water above and beyond normal precipitation. Although some irrigation techniques save water compared to other forms of irrigation, all irrigation requires extra water. The baseline for evaluating the ecological costs and benefits of irrigation should always be the unirrigated landscape and the natural water regime of the site. This does not mean that irrigation should be excluded from sustainable design. Rather, it means that irrigation should be used where it can really produce outstanding results in a resource-efficient way" (2000, p159). Thompson and Sorvig write that landscape irrigation consumes as much as seventy-five percent of residential water use in arid regions during the summer months—areas in the west and southwest United States are among the driest regions. Throughout the country, whether in arid Arizona or subtropical Florida, there is a critical need to reduce the overall amount of water used for landscape irrigation; many water efficient practices, most notably Xeriscape, have been

proven to significantly lower residential water use for landscape irrigation.

Xeriscape™ and Water Conservation

Xeriscape™ is a trademarked practice that approaches water conservation by designing and constructing landscapes for efficient water use. The system was trademarked by the Denver Water Department and the National Xeriscape Council, and is now in the hands of the University of Texas Extension. The seven principles of Xeriscape are: (1) Plan and Design; (2) Obtain a Soil Analysis; (3) Choose Proper Plants; (4) Use Turf Wisely; (5) Irrigate Efficiently; (6) Use Mulches; and (7) Perform Proper Maintenance. The central concept of Xeriscape is that plants with like water requirements are grouped together and high water-use plants are reserved for smaller areas where they will have maximum effect. These water use zones, or hydrozones, are grouped into high-, medium-, and low-water-use areas. The Xeriscape terms are **Oasis**, for the high water use area; **Drought Tolerant**, for the medium water use area; and **Natural**, for the lowest water use zone. Thompson and Sorvig describe a Xeriscape landscape plan using these three water use hydrozones: "Exotic, water-hungry specimen trees might be used at focal points in the landscape near a residence. A small and drought-tolerant lawn might be used in the same way, as a special feature. Moving away from the house, however, planting zones would contain more drought-tolerant plants….In the native zone, any planting would be done with species that could survive with no watering once established" (2000, p159). This technique

describes landscape planning using water conservation as the backdrop for design and plant placement. Can rearranging plants into water use zones and/or choosing less thirsty plants have any measurable effect on water use? In fact, water savings using Xeriscape practices can be significant.

Bond offers this example: "Assuming a 2,500-square-foot home on a quarter-acre lot with typical landscaping where 80% of the outside area is irrigable, 1 inch of water applied weekly to the entire irrigable area equals 4,184 gallons per week. Assuming the same dimensions where Xeriscape principles are integrated into the landscape design, 1 inch of water applied to 50% of the area (oasis zones), less water applied weekly to 25% of the area (drought tolerant zones), and no water applied to 25% of the area (natural zones), the requirement is 2,615 gallons per week. In this scenario, the landscape designed using Xeriscape principles requires 38% less water" (Bond, 1999, p32). He notes that 38% is a conservative estimate, since the scenario does not account for improved irrigation design and does not adjust for the over watering inherent in typical landscape designs. In addition, the percentages used to limit each of the zones can be adjusted; the Oasis Zone, for example, might be limited to 25% where there is no need for turf grass, and thus even greater water savings can be achieved. Even with Bond's conservative estimate, he writes that "landscapes designed and installed using Xeriscape principles versus typical landscapes in new residential communities would save 224,000 gpd [gallons per day] for every 1000 new homes built" (1999, p32).

The methods advocated by Xeriscape have received national attention and widespread support for their practical

water-saving applications. The Florida legislature adopted Xeriscape in 2001 as a means of water conservation for the state (373.185 F.S.); this will be discussed in detail in the following chapters. While Xeriscape legislation has ensured that water-efficient landscape irrigation practices are officially sanctioned by the state, the law only requires the WMDs to encourage and provide incentives for municipalities to amend their landscape ordinances with Xeriscape requirements. Thus, Xeriscape practices are *encouraged* rather than *required*; nevertheless, judging from the success of other non-regulatory education programs, like the Florida-Friendly Yards & Neighborhoods program, encouragement for sustainable practices can be very effective.

Florida Yards & Neighborhoods Program (FYN)

The Florida Yards & Neighborhoods Program is an educational outreach program created and implemented by the University of Florida IFAS Extension Service. The program was designed to educate homeowners about environmentally friendly landscape practices and how they can use these techniques to protect Florida's natural resources. Partners of the program, in addition to the University of Florida, the Cooperative Extension Service, and IFAS, include the U.S. Department of Agriculture, the five Water Management Districts, the National Estuary Program, the U.S. Environmental Protection Agency, and the Florida Department of Environmental Protection. Some city and county governments and local homeowners associations also

take part in promoting FYN. The program is currently active in 21 of Florida's 67 counties through each County Cooperative Extension Service. The mission of FYN is posted on the website as follows: "The Florida Yards & Neighborhoods Program was developed to address serious problems of pollution and disappearing habitats by enlisting homeowners in the battle to save our natural environment. This program provides special educational and outreach activities directed at the community to help residents reduce pollution and enhance their environment by improving home and landscape management" (http://hort.ufl.edu/fyn). It is important to note this is purely an educational program, not regulatory; however, FYN, or the term "Florida-Friendly Landscaping," is often used interchangeably with "Xeriscaping." There are nine principles of FYN: (1) Right Plant, Right Place; (2) Water Efficiently; (3) Mulch; (4) Recycle Yard Waste; (5) Fertilize Appropriately; (6) Control Yard Pests Responsibly; (7) Reduce Stormwater Runoff; (8) Attract Wildlife; and (9) Protect the Waterfront. The FYN Handbook is free to the public, and explains the "how-tos" of sustainable residential landscape practices in terms that the general public will understand.

The first principle, "Right Plant, Right Place," as explained in the Handbook: "Have you ever purchased a plant that looked great at the nursery or garden center, only to have it die once you planted it? Normally, you can avoid this heartbreaking scenario by putting the right plant in the right place; that is, by matching the plant to the site conditions in which it will thrive. Drought tolerant plants should be used on elevated dry spots, windy areas, exposed areas, plantings on

berms, and along the unshaded southern or western walls of buildings. Don't waste time, energy and resources caring for a plant not adapted to the microclimatic features of your yard….To reduce maintenance and conserve water in the landscape, group plants in beds according to water requirements and maintenance needs" (FYN Handbook, 2003, p 20-21.) The FYN Principles are very similar to Xeriscape™ principles, which were adopted by the Florida legislature as essential to water conservation efforts in the state. In fact, the terms "Florida-Friendly" and Xeriscape have become almost interchangeable when referenced in some model landscape ordinances, since the spirit of both practices is sustainable water conservation. At the heart of their similarities is the concept of "choosing the right plants for the right places."

Thayer writes, "Perhaps the most visible, direct facet of design in which the landscape architect works is the selection of plant materials. The landscape architect also bears responsibility for site planning, grading, drainage, and other factors of design relating to water, and genuine water savings can be achieved through better understanding of these principles. However, judicious selection of plant materials can often be the simplest, most immediate contribution of landscape designers to water conservation" (McPherson, Ed., 1984, p196). The importance of plant selection in sustainable landscape design will be discussed in detail in Chapter Five.

Chapter Four: Water Conservation in Pasco County

Pasco County: Growth & Land Development

"Pasco is a different kind of Florida. It's off the beaten path, where crowds are a distant memory, and a vacation is really a vacation. As the southern anchor to the Nature Coast….Pasco County is the all-natural choice for your next vacation."

http://visitpasco.net

Pasco County, located in west central Florida, is an example of an area of rapid development in the state. The county's western border is along the Gulf of Mexico, and the metropolis of Tampa-St. Petersburg is just south, in Hillsborough County (See Figure 4-1). The seven-county Tampa Bay region (Hernando, Hillsborough, Manatee, Pasco, Pinellas, Polk, and Sarasota counties) has been experiencing rapid growth for some time, but Pasco County's development has been more recent. Pasco was primarily an agricultural economy—home to two of the largest citrus packing plants in the world and acres of cattle and horse ranching; it was relatively undeveloped along its western coast until after World War II, when it became favored as a retirement area.

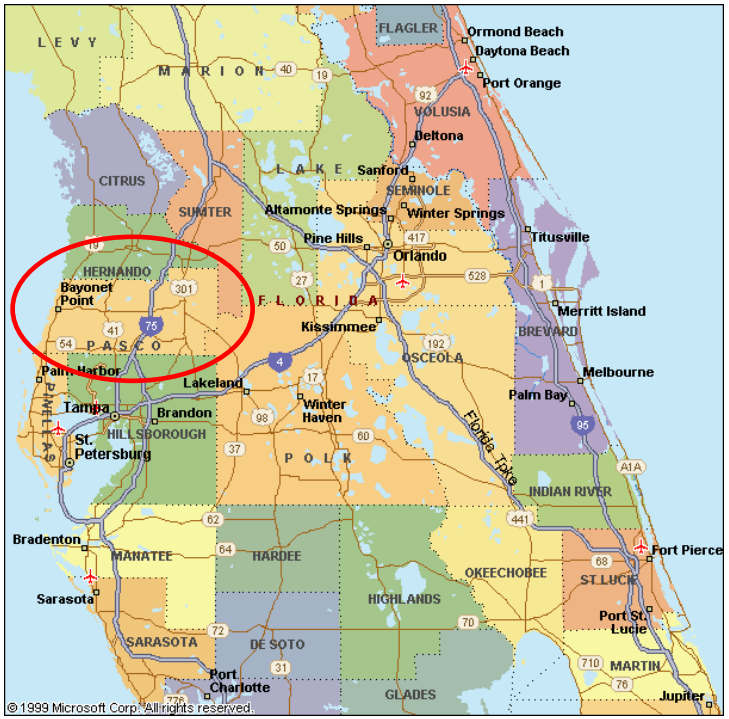


Figure 4-1: Central Florida. (Copyright 1999 Microsoft Corp.).

Since the Florida Department of Transportation (FDOT) built the Suncoast Parkway and opened it to the public in 2001 (a toll-road expansion project, part of the Florida Turnpike System), acres of developable land have become attractive to developers; more than 20,000 acres have been designated for future conversion to: 43,000 residential units, 8.4-million square feet of commercial space, 5.3-million square feet each of industrial and office space, and 1,120 hotel rooms, according to the Tampa Bay Business Guide (www.tampabay.org/businessguide/bayarea3). Some tourist advertisements bill Pasco as part of a nine-county region called the "Nature Coast," offering 100 square miles of managed recreation facilities, including parks, four artificial reefs (one made of surplus military tanks), more than 25 golf courses, and three state-designated canoe trails in Pasco County alone. The West Pasco Chamber of Commerce calls the county "a sun drenched paradise known as the 'Gateway to Tropical Florida'" (www.westpasco.com/paradise). The Central Pasco Chamber of Commerce has created a logo that reads: "Pasco County: It's Only Natural," and promotes its 20 miles of coastline on the Gulf of Mexico as "world-class fishing waters" (www.centralpascochamber.com).

Figure 4-2. Pasco County Cities. www.pascofla.com/pascomap/PascoCountyMap.

Pasco County encompasses 745 square miles and is comprised of six major municipalities (See Figure 4-2): Dade City (the County Seat): population 6,188; New Port Richey: population 16,791; Port Richey: population 3,070; Saint Leo, San Antonio, and Zephyrhills: population 11,495 (www.pascocountyfl.net and www.westpasco.com/pasco). Other cities are Aripeka, Bayonet Point, Elfers, Holiday, Hudson, Land O'Lakes, and Wesley Chapel. Data from the USA Counties IN Profile (updated Jan. 2005), shows that the population of Pasco County grew by 353.9% in the last 30 years of the 20th century (www.stats.indiana.edu/espr/a/usprofiles/12/us_over_sub_pr12201). Pasco is now ranked 10th in the state of Florida for rate of population growth; the 2003 estimated population was 388,906 (www.epodunk.com/top10/countyPop/coPop10).

Long-term population growth estimates for Pasco County from the Bureau of Economic and Business Research at the University of Florida (BEBR) indicate that by 2015, there will be as many as 439, 600 permanent residents. This is based on a 1.6% yearly change in population from 2005 to 2010, and a 1.5% yearly change from 2010 to 2014; from 2014 to 2015, a 1.4% yearly change was estimated (www.bebr.ufl.edu). Population estimates just released from the U.S. Census Bureau show the 100 Fastest-Growing U.S. Counties from July 2003 to July 2004. Fourteen Florida counties made the list; Pasco County ranked 38th in the nation with a 5% percent growth in population and ranked 25th in the nation for the largest numerical increase of 19,575 from July 2003 to July 2004 (www.census.gov).

Population growth, tourist attractions, and land use development indicators show that Pasco County will continue to experience steady rates of population growth and more land development; in an area already dealing with water restrictions, there will be even more pressure on water resources in the future. The implementation of water conservation measures is essential in Pasco County, as in all rapidly growing areas of the state.

Southwest Florida Water Management District

Pasco County is part of the Southwest Florida Water Management District (SWFWMD), which covers (entirely or in part) sixteen counties, nine basins, and two watershed systems. (See Figure 4-3).

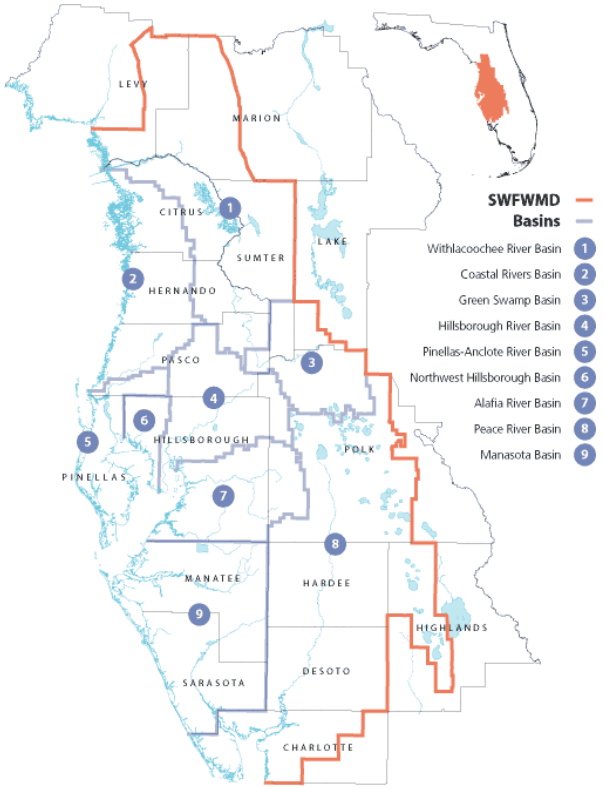


Figure 4-3. SWFWMD Area & Nine Basins. www.swfwmd.state.fl.us/data/map.

Watersheds in Florida are defined by the WMD's Comprehensive Watershed Management Initiative (CWM, pronounced "Sea-whim") based on drainage patterns and

using information from the U.S. Geological Survey. Started in 1994, the CWM Initiative uses a watershed-based approach to water and natural resources management in SWFWMD (www.swfwmd.wateratlas.ufl.edu/watershed/what_cwm). SWFWMD, like all five WMDs, is governed by an 11-member board that is appointed by the Governor and confirmed by the Senate for staggered four-year terms; each WMD produces a District Water Management Plan every five years that comprehensively addresses all aspects of its water resource management responsibilities, from designating Water Use Caution Areas (WUCAs) to Ambient Groundwater and Surface Water Quality Monitoring, to Well Construction Permitting. The WMDs were established in the Water Resources Act of 1972 (although SWFWMD, actually, was created first by a special act of the Florida Legislature in 1961 as the local sponsor of a major flood control project with the U.S. Army Corps of Engineers to repair damage after Hurricane Donna hit the state in 1960); since that time, WMD responsibilities have expanded to encompass a wide range of monitoring, permitting, and regulating endeavors that have largely proven effective as regional controls.

Current Water Use & Water Conservation Measures

"Water Use Trends in Florida, 2000," from the United States Geological Survey (USGS), reports: Pasco County's population was 344,765 in 2000, and 275,800 people were served with public water supply; total *withdrawals* for public supply in Pasco County for 2000 were 102.67 million gallons per day, all of which was groundwater withdrawal; and the

total water *use* for public supply was 35.23 million gallons per day (128 gallons per capita) (http://fl.water.usgs.gov/wateruse). The reason there is a distinction between *withdrawal* and *use* of water for public supply in Pasco County is because the county is part of a wholesale water distribution organization called Tampa Bay Water (TBW) that requires each municipality to transfer a portion of its water withdrawal to other counties in TBW. (TBW will be discussed in the following section.) Water *withdrawal* is that which is actually withdrawn within the county boundaries; water *use* is that amount that is actually used within the county boundaries; water *transferred* is that which is piped to another location outside the county boundaries.

According to Thayer and Richman, "about 25% of total residential water is applied outside the home, primarily for landscape irrigation" (MacPherson, Ed., 1984, p190). ***Using the USGS data and Thayer's estimate, in 2000, Pasco County might have used as much as 8.8 million gallons per day on landscape irrigation.*** SWFWMD estimates that as much as 30 to 50% of the water use of public supply is for landscaping purposes (Foley, 1999, p15). ***Using the USGS data and SWFWMD's estimate, the amount used for landscaping purposes from the total public supply water use per day for 2000 in Pasco County might have been as high as 10.57 mgd-17.6 mgd (50% of 35.23 mgd).*** Whichever estimate is used, the fact is that water use for landscape irrigation can be reduced through water-saving measures like Xeriscape. In an area that has already experienced water shortages, if population growth continues, water conservation will become more imperative.

Historical data from USGS on Pasco County's *total* freshwater withdrawals show that in 1990 there was 138.30 mgd withdrawn; in 1995, there was 141.59 mgd withdrawn, and in 2000, there was 141.93 mgd withdrawn. The total water withdrawal for *public supply* for each of those years is: 90.65 mgd in 1990; 93.93 mgd in 1995, and, as previously mentioned, 102.67 mgd in 2000. It is clear that public supply water use represents the greatest demand on total water withdrawal; however, the amount *withdrawn* for public supply, as previously mentioned, is not always the same as the amount *used*. In the case of Pasco County, the difference between the amount of water withdrawn for public supply and the amount of water used is the amount of water *transferred*; water withdrawn in Pasco County is exported and shared with nearby Pinellas and Hillsborough counties through TBW. The USGS data show that the water withdrawal for public supply and the water used for public supply in Pasco County from 1990 to 2000 has ***increased***: of the 90.65 mgd withdrawn in 1990, 65, 26 mgd was transferred, and **25.39 mgd** was used in Pasco County. Of the 93.93 mgd withdrawn for public supply in 1995, 67.79 mgd was transferred, and **26.14 mgd** was used in Pasco County. And of the 102.67 mgd withdrawn for public supply in 2000, 67.44 mgd was transferred, and **35.23 mgd** was used in Pasco County. Despite the use of reclaimed water through Pasco's Purple Rain Water Reuse program, water restrictions imposed by SWFWMD, and conservation efforts made through TBW, public supply water use in Pasco County appears to be increasing as population demand and development growth increase. If the adoption of water-conserving landscape design measures based on Xeriscape

principles continues to be promoted and enforced in Pasco County, the result may be a significant reduction in the amount of public supply water used for landscaping purposes.

Tampa Bay Water (TBW)

Tampa Bay Water is a special district created by interlocal agreement to supply wholesale water to Hillsborough, Pasco, and Pinellas counties and the cities of St. Petersburg, New Port Richey, and Tampa. Tampa Bay Water delivers a blend of surface water, groundwater, and desalinated water through a tri-county system of pipelines and water treatment facilities to its six member governments, which comprise over 2 million people. Current Water Supply infrastructure and planned supply infrastructure from Tampa Bay Water are shown in Figure 4-4. With nearly 200 miles of pipelines, TBW distributes an average of 162 mgd to the tri-county region using a 66 mgd Surface Water treatment Plant (supplied by three sources), six groundwater treatment plants, thirteen regional wellfields, and a 25 mgd seawater desalination plant. While TBW's current supplies are adequately meeting water demand, Tampa Bay Water's Master Water Plan projects that eight to twelve million gallons per day of new water will need to be developed to supply drinking water needs for the region by 2012 (www.tampabaywater.org/watersupply/futuresupplies). Again, this indicates that water demand for public supply is increasing steadily. While organizations like Tampa Bay Water can increase the efficiency of water use and perhaps regulate the distribution, other measures are still needed to curb the overall consumption as demand rises.

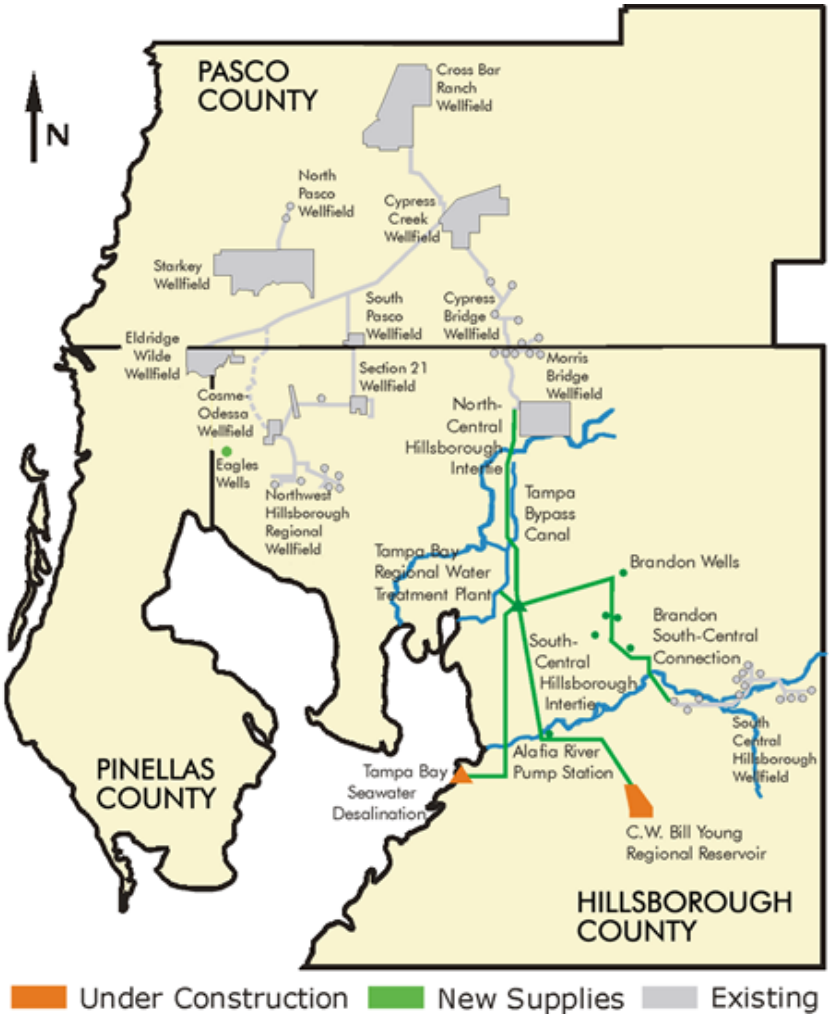


Figure 4-4. Current Water Supply Infrastructure Map of Tampa Bay Water. (www.tampabaywater.org/watersupply/currentsupplies).

Purple Rain Water Reuse System of Pasco County

In 1992, Pasco County developed a Reuse Master Water Plan to provide a framework for the ongoing expansion of the countywide reuse system, which has been supplying reclaimed water to the county since 1986. (Reclaimed water is household wastewater that is treated and filtered for reuse.) The Purple Rain Water Reuse System of Pasco County is an educational program that promotes the use of reclaimed water. In Pasco County, reclaimed water is distributed to residential communities to irrigate golf courses, sports fields, corporate landscapes, and residential lawns. There are three major interconnected reuse systems in Pasco County: the West Pasco Reuse System, the Central Pasco Reuse System, and the East Pasco Reuse System. Reclaimed water distribution service in West Pasco is primarily limited to golf courses, schools, and

parks, and the Reuse System discharges about five million gallons a day of surplus reclaimed water. (http://pasco.ifas.ufl.edu/water_conservation-outdoor/purple_rain/purple_rain_education_program).

Water Restrictions

Water restrictions have been a fact of life in south Florida for some time. The most recent Emergency Water Ordinance Amendment to affect Pasco County was proposed in March of 2003, and adopted in December of 2003. Ordinance No. 03-38 reads: "WHEREAS, Pasco County is responsible to protect the health, safety and general welfare, and to minimize public and private losses due to the harmful effects of water shortages within Pasco County, Florida; and WHEREAS, due to past drought, the level of water storage and ground water supplying the County and surrounding areas had become seriously low; and WHEREAS, the Southwest Florida Water Management District (SWFMWD) had issued Executive Order SWF 01-14, March 21, 2001, mandating local governments to declare an emergency and adopt plans to bring about a five percent reduction in water usage…" (Ordinance no. 03-38, from www.pascocountyfl.net).

An Emergency Water Ordinance Amendment, among other limits, imposes water restrictions on irrigation. Pasco County's Lawn Watering Times, effective December 12, 2003: "You may water on your watering day between the hours of 12:01 a.m. and 10:00 a.m. **OR** between the hours of 4:00 p.m. and 11:59 p.m. You may only water once on your approved day." A resident's watering day is based on his or her address number, and a chart is included to make that determination.

Everyday irrigation is allowed for newly installed landscaping, but only for a limited number of consecutive days, and only within allowed times of the day: "New turf, grass, and landscaping is exempt from the day of the week restrictions for the first 60 days after installation; however, such watering shall be limited to the minimum necessary, shall only be accomplished during the hours of 12:01 a.m. to 10:00 a.m. or the hours of 4:00 p.m. to 11:59 p.m. Only the newly planted lawn areas can be watered pursuant to this exemption. Accordingly, if 50% or more of any particular irrigation zone contains new grass or landscaping, that entire zone can be irrigated with lawn sprinklers any day for 60 days during allowable hours. If any particular irrigation zone contains less than 50% new grass or landscaping, then only the new grass or landscaping can be hand watered any day for 60 days during the hours allowed and lawn sprinklers cannot be used" (www.pascocountyfl.net/facts/waterR).

Pasco County's Landscape Ordinance

Pasco County's landscape ordinance (adopted 2/26/02) is part of the county's Land Development Codes, under General Land Development Standards. Article 603, Landscaping and Buffering, accompanied by Appendices A, B, and C, includes landscape design and irrigation requirements for new residential lots and three classes of development projects. Article 603 incorporates the use of two of the water-conserving landscape design strategies identified in the five model landscape ordinances discussed in detail in Chapter Five: (1) Plants grouped into hydrozones: "Installed trees and

plants shall be grouped together into landscape plant zones according to water and cultural (soil, climate, and light—microclimate) requirements. Plant groupings based on water requirements are as follows: drought tolerant, natural, and oasis," and (2) Use of native plants is required: "A minimum of thirty (30) percent of the plant materials, other than trees and turfgrass, shall be native Floridian species, suitable for growth in Pasco County" (www.pascocountyfl.net/devser/sd/dr/ldc/t600).

The Pasco County landscape ordinance is currently being updated and refined to clarify and strengthen the design requirements, some of which have reportedly not been as successful as intended; however, the Design Resources created by this thesis project: the Hydrozone Plant Selection Guide and the Natural Plant Community Guide, are compatible with the existing ordinance, will be compatible with the revised ordinance, and can certainly be adapted for use in any city or county landscape ordinance in the state.

Pasco County Plants & Plant Communities

Pasco County is in United States Department of Agriculture (USDA) Plant Hardiness Zone 9A, based on 60-year average minimum winter temperatures of 25˚ to 20˚ F. Figure 4-5 shows the USDA Hardiness Zones for the state of Florida; Pasco County is circled in red.

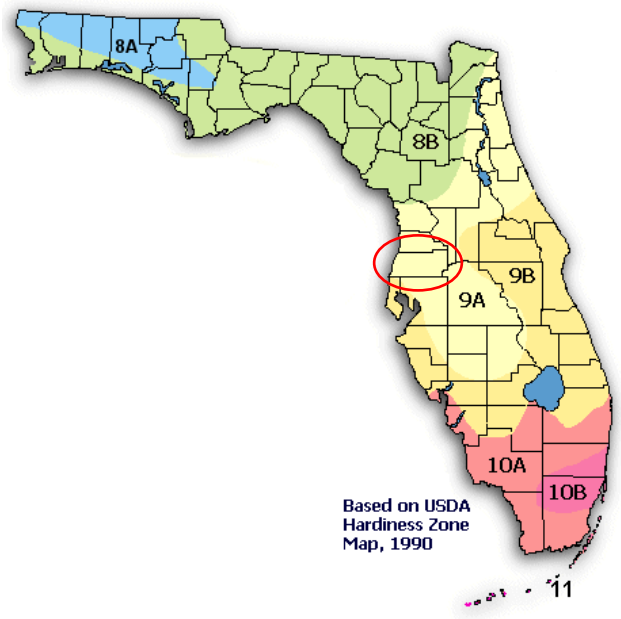


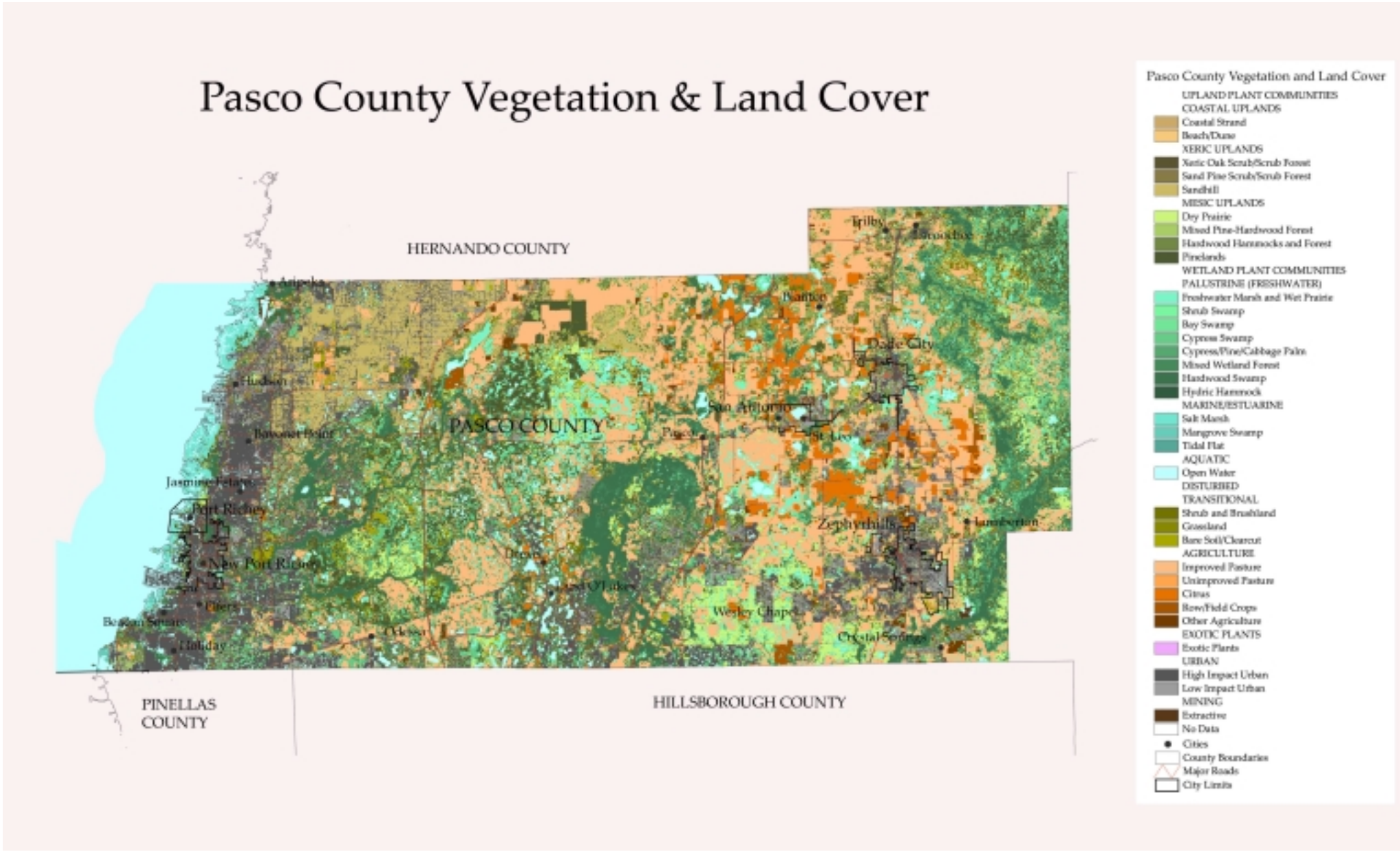
Figure 4-5. USDA Hardiness Zones Map, 1990. www.fnps.org/pages/plants/landscape_plants/floridamap.

Figure 4-6 shows a Geographic Information Systems (GIS) map of Pasco County's vegetation and land cover types, created by the author with ArcView 3.2a using the Florida Fish and Wildlife Conservation Commission's Vegetation and Land Cover Data Derived from 2003 Landstat EMT+ Imagery. This dataset also includes descriptions of each vegetation and land cover type. The Florida Natural Areas Inventory (FNAI) defines a natural community as "a distinct and reoccurring assemblage of populations of plants, animals, fungi and microorganisms naturally associated with each other and their physical environment"(www.fnai.org/descriptions). According to the Pasco County Vegetation & Land Cover map in Figure 4-6, Sandhill community predominates in the northwestern area of the state, while further southwest, Hardwood Swamp and Hydric Hammock are clearly present. High and Low Impact Urban areas dominate the western coastline. Just east of Drexel and Land O'Lakes, another large Palustrine area is apparent, with Wet and Dry Prairie areas around Wesley Chapel and Crystal Springs. In the northeastern area of the

state, amidst the triangle of Zephyrhills, Dade City, and San Antonio, areas of Citrus farms and Improved Pasture are interspersed with High and Low Impact Urban and areas of Open Water. Along the eastern boundary of Pasco County, every freshwater wetland plant community in the legend is visible. The map indicates that Pasco County is still home to many areas of diverse natural communities that must compete with the historical impacts of agriculture and urban development. While large natural areas are still visible, these areas may be increasingly threatened with a loss of habitat connectivity as development and population grows.

Future Concerns for Pasco County

Pasco County is a classic example of a rapidly growing area of Florida, an area of rich natural diversity and fertile cropland alike, an area welcoming thousands more people and thousands more square feet of residential and commercial development every day, and an area with water resources that struggle to meet the demands of growth. There is no question of whether growth will continue in Pasco County; the question is: how will the county keep up? The intent of this thesis project is to offer additional resources in support of current water-conserving landscape design measures for curbing public supply water use for landscaping purposes in Pasco County.


Pasco County Vegetation & Land Cover
HERNANDO COUNTY
PASCO COUNTY
PINELLAS COUNTY
HILLSBOROUGH COUNTY
Aripeka
Hudson
Bayonet Point
Jasmine Estates
Port Richey
New Port Richey
Holiday
Trilby
Lacoochee
Ivanhoe
Dade City
San Antonio
St Leo
Zephyrhills
Lutz
Wesley Chapel
Crystal Springs
Pasco County Vegetation and Land Cover
UPLAND PLANT COMMUNITIES
COASTAL UPLANDS
Coastal Strand
Beach/Dune
XERIC UPLANDS
Xeric Oak Scrub/Scrub Forest
Sand Pine Scrub/Scrub Forest
Sandhill
MESIC UPLANDS
Dry Prairie
Mixed Pine-Hardwood Forest
Hardwood Hammocks and Forest
Pinelands
WETLAND PLANT COMMUNITIES
PALUSTRINE (FRESHWATER)
Freshwater Marsh and Wet Prairie
Shrub Swamp
Bay Swamp
Cypress Swamp
Cypress/Pine/Cabbage Palm
Mixed Wetland Forest
Hardwood Swamp
Hydric Hammock
MARINE/ESTUARINE
Salt Marsh
Mangrove Swamp
Tidal Flat
AQUATIC
Open Water
DISTURBED
TRANSITIONAL
Shrub and Brushland
Grassland
Bare Soil/Clearcut
AGRICULTURE
Improved Pasture
Unimproved Pasture
Citrus
Row/Field Crops
Other Agriculture
EXOTIC PLANTS
Exotic Plants
URBAN
High Impact Urban
Low Impact Urban
MINING
Extractive
No Data
Cities
County Boundaries
Major Roads
City Limits

Chapter Five: Water Conservation in Landscape Design

Resource Conservation in Landscape Design

"The small steps taken to build sustainability into the local landscape in discreet, manageable chunks which people can observe, try out, experience, and improve are actually large steps for humankind."

From ***Gray World, Green Heart*** *by Robert Thayer*

Competition between agricultural, industrial, and urban development for natural resources will continue to compel professional designers and developers to plan for conservation from the beginning of each project. Conserving resources will, more and more, become a practical necessity that saves money and literally "buys time" for development to continue to thrive in Florida. In 1996, the Florida Department of Community Affairs and the Florida Energy Office funded the production of a book by Ewing, et al, entitled: *Best Development Practices: Doing the Right Thing and Making Money at the Same Time*. Ewing and his co-authors write, "Florida is expected to grow by five million people over the next 20 years. Without changes in development policy and practice, this growth will take the form of urban sprawl, sprawl being Florida's now-dominant development pattern. The economic and social costs will be enormous. In *Best Development Practices*, we define good community development, as distinct from sprawl, in operational terms. Public purposes loom large, though not at the expense of market considerations. Recommendations go to the enlightened edge of current development practices, but not so far beyond as to lose our target audience, you, the developer. The public purposes pursued through these best practices—affordable housing,

energy efficiency, and preservation of natural areas, among others—make good business sense" (Ewing et al., 1996, p1). The book's recommendations cover four aspects of development: land use, transportation, environment, and housing; the information is also designed for government planners and public officials as principles on which to base comprehensive plans and land development regulations. Although the recommendations for natural resource conservation are detailed in *one* of the four sections of the book, rather than woven into every aspect of the other sections on land use, transportation, and housing, the Best Environmental Practices section begins with Practice 1, which advocates a "systems approach" to environmental planning. A systems approach is explained as "an overarching recommendation…Other best practices complement and embellish it. Planning and regulatory emphasis is shifting from the individual development site to the basin or ecosystem. The shift is prompted by the realization that functional systems are the appropriate units of environmental analysis and management" (Ewing et al., 1996, p92). In addition to the systems approach, the Best Environmental Practices include the following recommended Practices 2-12:

2. Channel development into areas that are already disturbed
3. Preserve patches of high-quality habitat
4. Design around significant wetlands
5. Establish upland buffers around all retained wetlands and natural water bodies
6. Preserve significant uplands, too
7. Restore and enhance ecological functions damaged by prior site activities

8. Minimize runoff by clustering development on the least porous soils and using infiltration facilities
9. Detain runoff with open, natural drainage systems
10. Design man-made lakes and stormwater ponds for maximum environmental value
11. Use reclaimed water and integrated pest management on large landscaped areas, and
12. Use and require the use of Xeriscape™ landscaping" (Ewing et al., 1996, p91).

While these twelve practices are aimed at improving environmental quality—and in some cases, quantity—water conservation is only one of the benefits of these considerations. For specific water conservation strategies designed to improve land development practices, the authors of *Best Development Practices* recommend other important references, such as Robinette's *Water Conservation in Landscape Design and Management* (1984), and McPherson's *Energy-Conserving Site Design* (1984). These resources provide more depth and specificity, and also provide an additional dimension to the explanations of land development practices: diagrams and illustrations which offer visual guidance for understanding recommended methods. These illustrations can help to convey written concepts by supporting them visually—an important element when presenting information to an audience of designers and visual thinkers.

Water Conservation Strategies in Landscape Design

Robinette writes that there are three general strategies for landscape design and management for water conservation: (1) Use available water more carefully; (2) Design or redesign a landscape so that less water is required; and (3) Apply water

to plants more precisely (1984, p2). These three conceptual strategies provide the framework for an exploration of methods and practices that use water judiciously. Robinette explains in detail a range of specific practices for conserving water in the landscape, including:

1. Control Water Falling on the Site
2. Use Drought Resistant Vegetation
3. Leave Plants in a Stress Condition
4. Erect Wind Barriers
5. Redesign/Renovate to Reduce Water Requirements
6. Alter Cultivation Practices
7. Modify Soils
8. Expand the Use of Mulch
9. Use Anti-Transpirants
10. Re-use Water
11. Make Water "Wetter"
12. Establish Water Priorities
13. Alter/Adjust Irrigation Practices, and
14. Use Irrigation Water More Efficiently

The following illustrations are from Robinette's section 5 on Redesigning/Renovating to Reduce Water Requirements. Figure 5-1 shows a multi-family site "before" and "after" drawing to demonstrate this kind of redesign. In the "Before" drawing, there is an extensive area of turf to be irrigated; a hot area with high water use plants that requires irrigation; no wind blocks so that a drying wind pulls moisture out of the soil; and the grading is designed to push water off the site. In the "After" drawing, mulch replaces some of the turf on heavily used areas; there are more plants to shade hot areas and reduce irrigation needs; the buildings are staggered to provide shade and windbreak; and water is collected for use with berms that direct water onto the site.

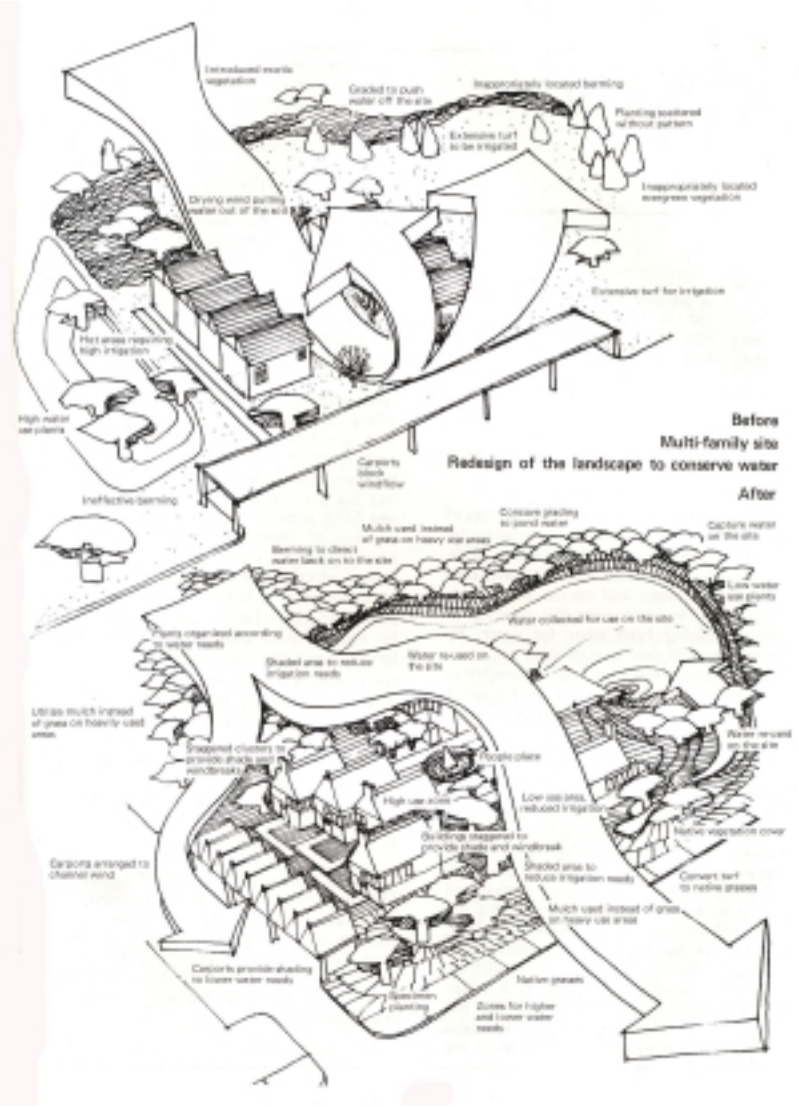


Figure 5-1. Before and After Multi-Family Site. Robinette, 1984, p127.

In Figure 5-2, Robinette shows a single-family site. The "Before" drawing shows widely scattered trees that are difficult to water, extensive turf to be irrigated, high water use plants, and exotic vegetation. The "After" drawing shows plants organized according to water needs, turf converted to native grasses, native or xeric adapted plants, and high water use plants placed in lee of the building to reduce irrigation.

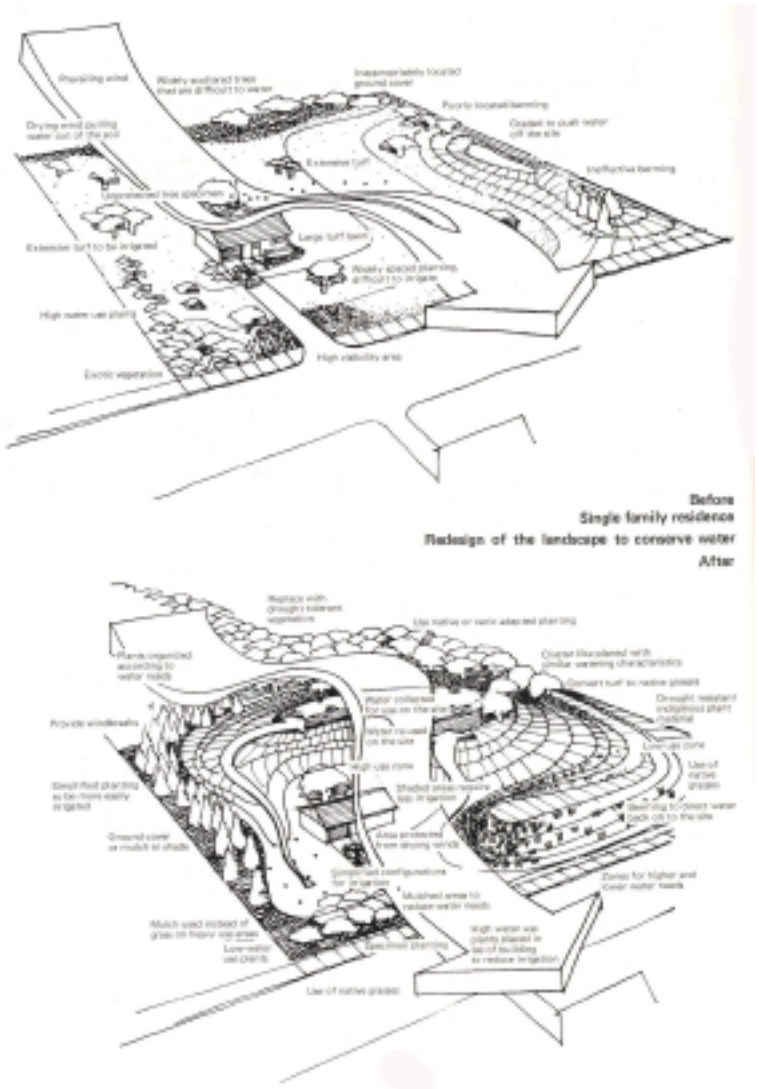


Figure 5-2. Before and After Single-Family Site. Robinette, 1984, p126.

The landscape design requirements in the model water-conserving landscape ordinances analyzed for this project, as well as the Pasco County ordinance, incorporate the majority of Robinette's suggested practices for using available water more judiciously and redesigning so that less water is needed. The landscape design standards and requirements make use of existing Xeriscape™ legislation in the state of Florida and capitalize on the growing popularity of using native plants as a water-saving measure. Each of the landscape ordinances analyzed for this thesis project uses different language to describe requirements; however, all five have strategies in common that have formed the basis for the new resources proposed by this project.

Water Conservation in Model Landscape Ordinances

A preliminary step for this project was to analyze five water-conserving model landscape ordinances for similarities and differences in the landscape design requirements. The five ordinances are:

1. Guidelines for Model Ordinance Language for Protection of Water Quality and Quantity Using Florida Friendly Lawns and Landscapes ["FL-Friendly"]
2. Guidelines for Creation of Local Landscape Water Conservation Ordinances to Qualify for the St. Johns River Water Management District Ordinance Implementation Incentive Program ["SJRWMD"]
3. Homestead, FL, Landscape Ordinance ["Homestead"]
4. Sarasota County Water Efficient Landscape Ordinance ["Sarasota Co."]
5. Model Water Efficient Irrigation and Landscape Ordinance Developed for Tampa Bay Water Member Governments ["TBW"]

All five landscape ordinances share at least two of the following strategies: (1) appropriate plant selection, location, and arrangement in water use zones, or hydrozones, based on microclimate considerations; (2) preservation of native vegetation and/or use of native plants; and (3) limitations on turfgrass placement. The following chart, Figure 5-3, shows all three strategies and identifies with Y=yes and N=no which landscape ordinances include requirements (with some variations) for each strategy. Under the three strategies, a list of related requirements suggests how comprehensively each strategy is addressed in each ordinance. For example, all five of the model landscape

ordinances include Strategy 1, requirements for selecting and grouping plants according to water needs (hydrozones) and microclimate suitability. Only one model landscape ordinance, the "FL-Friendly" model ordinance, includes a requirement for a soil analysis, which might be helpful for assessing microclimate areas and making hydrozone placement decisions for plant selection. Two ordinances, the "FL-Friendly" ordinance and the "Sarasota Co." ordinance, place a limit on the area designated as a High Water Use zone. And four of the model landscape ordinances, the "FL-Friendly," "SJRWMD," "Homestead," and "Sarasota Co." ordinances, recommend the use of reclaimed or graywater for irrigation when available. Four of the model landscape ordinances, "FL-Friendly," "SJRWMD," "Homestead," and "TBW" include a requirement for native vegetation preservation.

Strategy 1: Grouping Plants w/ Similar Cultural & Water Needs: Hydrozones					
	FL-Friendly	SJRWMD	Homestead	Sarasota Co.	TBW
Plant Selection/Group by Hydrozone	Y	Y	Y	Y	Y
Soil Analysis Required	Y	N	N	N	N
Limit on High Water Use Zone	Y	N	N	Y	N
Reclaimed/Graywater for Irrigation	Y	Y	Y	Y	N
Strategy 2: Required Native Vegetation Preservation and/or Use of Native Plants					
	FL-Friendly	SJRWMD	Homestead	Sarasota Co.	TBW
Veg. Survey Req. for Site Plan	Y	Y	Y	N	N
Native Vegetation Preservation Req.	Y	Y	Y	N	Y
Specific Percentage Req. for Pres.	Y	Y	N	N	N
High Ecologial Importance Priority	Y	Y	N	N	N
Off-site Preservation Option	N	Y	N	N	N
Native Plants Encouraged/Required	N	N	Y	N	N
Stormwater Re/De-tention w/Natives	N	N	Y	N	N
Strategy 3: Limits on Turfgrass					
	FL-Friendly	SJRWMD	Homestead	Sarasota Co.	TBW
Percent Limit onTurfgrass Area	N	Y	Y	Y	Y

Figure 5-3. Three Water-Conserving Landscape Design Strategies Found in Model Landscape Ordinances. (author).

Only the FL-Friendly and SJRWMD ordinances set a specific percentage for preservation; the former states that this is to be decided by the local government, and the latter suggests a

minimum of 10% of a site planned for development be set aside for preservation. Both of these ordinances indicate that areas of native vegetation with "high ecological importance" be given priority for preservation, and both stipulate that if this should prove an undue burden on the development, it is the developer's responsibility to prove such hardship and provide an acceptable alternative. Only the SJRWMD ordinance offers an off-site preservation option (and the option of a contribution to a Water Conservation Fund, although this is not included in the related strategies list).

While all five ordinances require the use of "site-appropriate" or "drought-tolerant" species of plants, only one ordinance, Homestead, specifically requires the use of "locally adapted native plant species," and [w]here feasible, the reestablishment of native habitats...in the landscape plan." Homestead's ordinance is also the only model landscape ordinance to stipulate that, where feasible and with some exceptions, stormwater retention and detention areas should be planted "with native herbaceous facultative plants."

Strategy 3, which limits the amount of turfgrass area on the landscape plan, is required in four of the model landscape ordinances: SJRWMD, Homestead, Sarasota Co., and TBW, with a maximum of 50% of the landscaped area permitted for lawn. In general, the ordinances note that drought-tolerant and/or native groundcovers, grasses and forbs are permitted for areas beyond the maximum area allowed for turf. Excerpts of each landscape ordinance in the Appendix show in detail the similarities and differences between ordinance language used and the specific requirements of each general strategy.

Applying Water Conservation Strategies to Design

As shown in the previous section, the requirements of water-conserving model landscape ordinances employ three main strategies to reduce water use for irrigation in landscape design. It is clear that these measures (grouping plants into hydrozones based on microclimates; preserving native vegetation and using site-appropriate, often native, plants; and limiting the use of turfgrass) result in significant water savings. How do these water-conserving methods apply to the design process? A closer analysis of each strategy reveals how landscape designs can be enhanced through the use of water conservation measures.

***Strategy 1*: Microclimates & Hydrozone Placement**

Landscape architects Thayer and Richman write that water-conserving landscape design is best achieved by emphasizing two approaches: "the physical ecology of plants and plant communities in relation to micro site conditions, and the human ecology of land uses in relation to potential need for additional water or irrigation above that which naturally occurs" (McPherson, Ed., 1984, p197). The "physical ecology of plants," means selecting plants according to microclimates and natural plant communities, and hydrozoning, or grouping selected plants according to their water demands. The "human ecology of land uses" suggests that designating hydrozone areas on a site requires analysis and synthesis of placement based on patterns of human use as well as on physical suitability. Thayer and Richman write that designing

according to microclimate considerations, or "ecological planting design—emphasizes a thorough examination of the water, soil, sunlight, wind, and other micro-environmental factors in relation to plant communities, whether strictly native or adapted to the region. 'Natural landscaping' is a term frequently used to describe such considerations, and although somewhat misleading as a label, is aimed at matching the specific microsite and climate condition with plants native to those conditions. The logic here is sound; plants ideally suited to climate, soil, sun, wind, and other site conditions require less energy, water, and maintenance to grow and thrive than exotics. They may in some cases constitute the beginning of a plant community that evolves to make a pleasing landscape with little further investment in resources or manpower" (McPherson, Ed., 1984 p197).

Therefore the first approach, according to Thayer and Richman, is to examine the microclimates of a site as a means of discerning the most suitable areas for plant and hydrozone placement.

A microclimate is the climate of a specific area in a landscape site that has substantially differing light exposure, temperature, wind, and/or soils than surrounding areas or the area as a whole. The two microclimate considerations most commonly applicable to plant placement, soil characteristics and light exposure, will be addressed in the design resources of this project, although all considerations are useful during site inventory and analysis.

Soils – Soils are usually classified by soil structure, according to the size of their particles. At one end of the spectrum is coarse gravel, with particles larger than 5

millimeters in diameter, and at the other end is clay, with particles smaller than .005 millimeter in diameter. In between is a gradation of soils based on decreasing particle size: first, coarse gravel, then fine gravel, coarse sand, fine sand, sandy loam, loam, silt loam, silt, and finally, clay. Soils with larger particles are considered "light" or "sandy" soils; soils with medium-sized particles are "loamy;" and soils with small particles are "heavy" or "clay" soils. These soil textures are generally characterized according to how particle size affects drainage and fertility. Light or sandy soils are usually Well-Drained (WD) and rich in oxygen since water and air can move freely among the larger particles; however, water can drain out of light soils more quickly, taking nutrients and leaving the soil dry and infertile. Heavy or clay soils, on the other hand, have little space for water and air to circulate; thus these soils are often referred to as Poorly Drained (PD), since they hold water and nutrients longer. Loamy soils, referred to as Moderately Well-Drained (MW), are generally considered "the happy medium," allowing water to drain without losing nutrients. (It is important to recognize, however, that combinations of soil types can blur these distinctions, and general categories are used for the sake of simplifying a rather complex science.)

These three general soil categories based on drainage characteristics, Well-Drained (WD), Moderately Well-Drained (MW), and Poorly Drained (PD), can be used to determine areas of a site that are more or less suitable for plants with particular water demands, or soil moisture preferences. Wherever site conditions are such that the original soils are easy to determine, it is usually practical, sustainable, and often

cost-effective to determine whether it is possible to work with the soils as they already are. (This is usually part of a landscape architect or designer's site survey.) However, especially in urban and disturbed areas, soils are often amended, mulches are added, and the original soil type on a site might be removed or buried because off-site "fill" has replaced it during the site clearing and grading process. Nevertheless, an understanding of the characteristics of soil, whether native or disturbed, is a sound basis for discerning distinct microclimate areas of a site. Light exposure, however, is just as important.

Light – The sun/shade conditions on a site are determined by observing which areas receive direct, indirect, or no sunlight over the course of a day. Light exposure needs for plants are generally grouped into three categories: Full Sun (FS), Part Sun (PS), and Shade (S). A plant that is said to prefer Full Sun needs at least 6 hours of sun a day between 10:00 A.M. and 6:00 P.M. Daylight Savings Time (Damrosch, 1988 p37). Plants that prefer Part Sun should be given shade during the hours when the sun is the strongest, or else placed in an area where the sunlight is broken in some way. Damrosch writes that this is "variously described as 'filtered light' [or] 'dappled shade'" (1988 p37). Part Sun areas also include areas of "bright shade," where no sun falls, but where reflected light from surrounding areas still provides some light. These "bright shade" areas, which are technically shaded because there is no direct sun, are nevertheless appropriate for plants that prefer a range of light from Part Sun to Shade. Plants that prefer only Shade are likely to be best for areas referred to as

"Deep shade," where there is no direct sun or reflected light (Damrosch, 1988, p38).

Patterns of sun/shade change seasonally, as well as daily; because site surveys must be carried out relatively quickly, landscape architects and designers use experience and knowledge to estimate annual sun/shade coverage. (There are also computer programs that use precise coordinates to show the movement of light across a site throughout a day or a year.) Identifying the sunniest and the shadiest areas of a site is important for matching the right plants to the right conditions. Even more important is determining the way that sun/shade conditions interact with soil conditions to create different microclimates.

An example of a microclimate created by the interplay of light and soil is an area of a site with well-drained, or sandy, soils that is heavily shaded by canopy trees. How will this affect the conditions for a plant? The matrix in Figure 5-4 shows that different microclimates are created from the combination of a variety of soil types and a variety of sun/shade scenarios. An area with a combination of well-drained (WD) soils and shade (S) creates a different condition for a plant than an area with well-drained (WD) soils and full sun (FS). An area with full sun will likely have much more rapid evaporation than a shady area, and because the soil type is well-drained (and thus does not hold water for long) the result is a comparatively hotter and drier area. Compare that with an area of poorly drained soil (PD) and full sun (FS); this microclimate area will be comparatively wetter than the area with well-drained (WD) soils and full sun (FS); although there

is still rapid evaporation from the heat of the sun, the soil retains moisture longer.

Microclimate Variations

Sun/Shade Requirements	Soil Drainage Types			
		Well Drained (WD)	**Moderately Well Drained (MW)**	**Poorly Drained (PD)**
	Full Sun (FS)	FS/WD	FS/MW	FS/PD
	Part Sun (PS)	PS/WD	PS/MW	PS/PD
	Shade (S)	S/WD	S/MW	S/PD

Figure 5-4. Generalized Microclimate Variations. (author).

Even at this extremely general level, the three categories of soils and three categories of light exposure yield nine microclimate combinations. Employing more specific soil types and actual variations in light conditions on a site would yield an even greater number of microclimate variations, but for the sake of simplicity, only the general types will be discussed. While these differences may seem subtle, successful plant placement and thoughtful hydrozone placement decisions based on microclimates will result in measurably dramatic results—thriving plants and significant water savings. In fact, identifying and understanding the microclimates of a site provides an excellent basis for hydrozone placement decisions.

Hydrozones – A hydrozone is defined as "a distinct grouping of plants with similar water needs and climatic requirements." In other words, the conditions of a microclimate can be used to determine hydrozone placement, and thus, plant selection. A hydrozone requirement stipulates planting plan organization according to water use zones; each zone represents an area where plants are grouped according to

high, medium, or low water needs. Several of the model landscape ordinances, as well as the WMD's *Waterwise Florida Landscapes* guide use the following Xeriscape terms to group plants into hydrozones:

1. Natural: once established, these plants survive on rainfall without the need for supplemental irrigation
2. Drought-Tolerant: once established, these plants survive on natural rainfall with occasional irrigation during dry periods, and
3. Oasis: once established, these plants require frequent irrigation to survive.

How does this first model water-conserving landscape ordinance strategy, which is based on the concept of grouping plants into hydrozones, affect the design decisions of a landscape plan? Establishing hydrozones based strictly on microclimates suggests an ecological determinist approach to hydrozone design; however, the "hydrozone concept" lends itself to a variety of design applications.

Hydrozone Design – Thayer and Richman point out that hydrozoning, or "the human ecology of water use," as they term it, "adds a new twist to the design process in that it requires the site to be analyzed according to predicted or planned human use intensity" (MacPherson, Ed., 1984, p198). In their second approach, Thayer and Richman suggest that hydrozone placement decisions should be related to the patterns of human activity in a site design: "By examining areas within the site according to the potential frequency and types of human activity, areas of water use intensity, or 'hydrozones,' can be established to enable the designer to maximize the functional efficiency and psychological effect of

water and energy applications to the landscape. *Through hydrozonic landscape planning and design, the water use within a given site is varied in proportion to the varying use intensities of different portions of the site*….Detailed land use, space utilization, circulation patterns, and other variables that determine water needs are important factors in the design program and must be considered throughout the planning process if the hydrozonic approach is to succeed" (MacPherson, Ed., 1984, p198). Thayer and Richman show how high, moderate, and low water levels of human activity/intensity can be designed around levels of high, moderate, and low zones of water use in Figure 5-5. These section drawings show how design decisions can be guided by water use requirements using appropriate buffers, circulation decisions, designation of focal points, and areas of human interaction that correspond water use to human use.

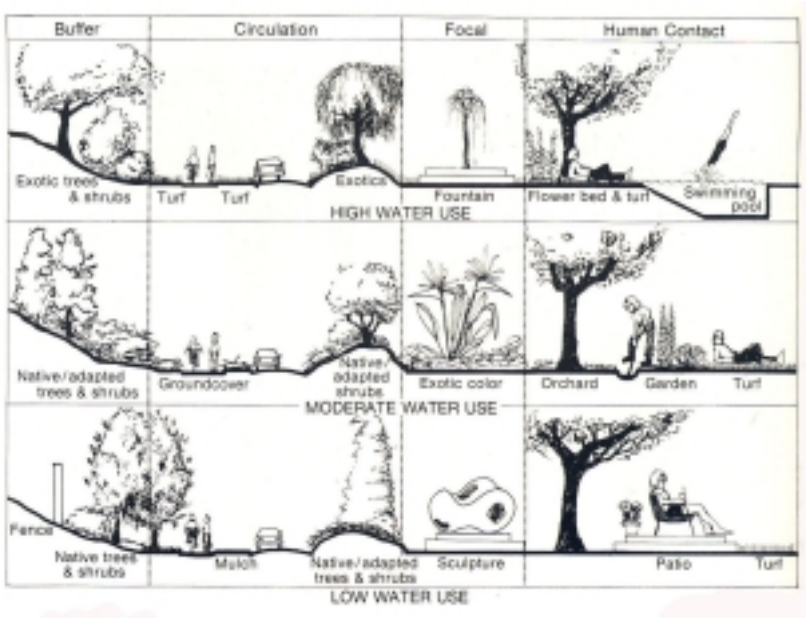


Figure 5-5. Water Use Related to Human Use. McPherson, Ed., 1984, p. 208.

These section illustrations show the relationships between water use and human use, but how does this theory apply to design decisions in plan view? Thayer and Richman provide an example of a four hydrozone (rather than three hydrozones, as Xeriscape principles suggest) single-family

landscape plan showing placement decisions based on (1) principal, (2) secondary, (3) minimal, and (4) elemental hydrozoned areas of human use/water use in Figure 5-6. The placement of hydrozones in this diagram is driven by the homeowners' program of human uses. According to this sample layout, the principle hydrozone "represents the area within the site that experiences both the greatest human impact upon the land and the largest subsequent water and energy use" (McPherson, Ed., 1984, p198). In a residential site, this is usually considered to be the back yard area "where people have the most direct contact with the landscape—where they play, run, sit, or lie down to relax….Intensive human activity in the principal hydrozone justifies the greatest water and energy use here" (McPherson, Ed., 1984, p198). The secondary hydrozone contains areas that are "visually important but less physically manipulated by human activity…including areas for passive recreation, space delineation, or focal interest" (McPherson, Ed., 1984, p198).

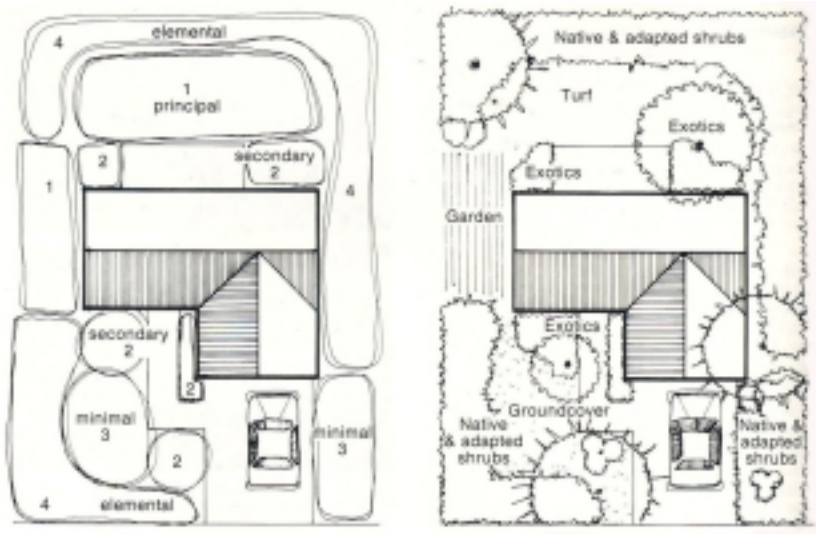


Figure 5-6. Four Hydrozone Landscape Plan for Single-Family Lot. McPherson, Ed., 1984, p. 200.

In a residential site, this might be a flower bed or focal shrub near the front entrance. The minimal hydrozone area "receive[s] little or no human use, and therefore justif[ies] little

irrigation or related energy expenditure. These include buffer zones, distant views, and directional delineators such as median strips and highway embankments. These areas…are matched with landscape material that survives with only slightly more water than natural rainfall" (McPherson, Ed., 1984, p198). The fourth area, the elemental hydrozone, is designated wherever the site receives only natural rainfall; in a residential site, "utility areas, mulched parkways, unirrigated plants, or naturally existing vegetation belong to the elemental hydrozone" (McPherson, Ed., 1984, p198). The "hydrozone concept," as Thayer and Richman have defined it, does not dictate design decisions; instead it guides and illustrates a process by which a water-conserving landscape design can be created.

Thomas Christopher, landscape designer and author of *Water-Wise Gardening: America's Backyard Revolution*, a book aimed at teaching homeowners and backyard gardeners about Xeriscaping, discusses hydrozoning as a practical measure for organizing both form and function in a design: "Organizing plants into zones of uniform water needs makes precise watering possible, but even greater savings can be realized through a rational arrangement of the different zones. For the sake of simplicity, the National Xeriscape Council suggests dividing the landscape into high-, medium-, and low-water-use zones. Most commonly, xeriscape design calls for keeping the high-water, lusher zones small. At the same time, it maximizes their impact by setting them right next to the house, distributing them around decks, terraces, and other outdoor seating areas to create what xeriscapers call a 'mini-

oasis.' As you move away from the house, the xeriscape typically becomes less intensively cultivated (and watered), progressing through medium-water-use zones to a periphery of low-water-use plantings, a zone that may receive no artificial irrigation at all once the plantings have rooted into the soil" (Christopher, 1994, p58). Again, as Christopher explains, the hydrozone concept can be used to plan for water use as well as for aesthetics and human use. In fact, using the hydrozone concept is a sustainable design challenge which requires designers to harness creativity and sensitivity in equal measure. The first of two Design Resources created for this thesis project, the Hydrozone Plant Selection Guide, is intended to support hydrozone design by grouping plant lists primarily by water demand and secondarily, by light exposure needs. The Hydrozone Plant Selection Guide will be discussed further in Chapter Six.

***Strategy 2*: Preserving Native Vegetation & Using Native Plants**

Preserving Native Vegetation – Another important strategy in water-conserving landscape ordinances is emphasizing the importance of preserving native vegetation. Preserving areas of native vegetation saves water primarily by reducing the amount of landscaped area that requires irrigation; however, there are many additional benefits. The natural health and hydrology of the site is sustained, the attractiveness of the site increases its economic value, and the costs of development and maintenance decrease measurably. The initial cost-savings of leaving a portion of a site *un*-cleared

is only the first advantage; in addition, preservation protects natural areas from soil compaction, allowing for natural stormwater infiltration; native soils require no amendments, thus eliminating the need for fertilization or soil improvement; and natural landscaping requires no maintenance, thus saving energy and money from development through completion. Conventional landscaping practices begin with a cleared site, which requires that every square foot be re-vegetated and irrigated. This expense is often unnecessary and, in fact, can be destructive to the natural health of the site. The value of the existing natural systems on an uncleared site are surprisingly underrated; the irony is that the established landscape is usually what sets the price—property denuded of vegetation is not considered as valuable. Wasowski notes, a "natural habitat is a self-sustaining environment," and there are many economic benefits to be enjoyed from a landscape area that requires no maintenance (2000, p30). A natural area is one that thrives without help from humans; no irrigating, fertilizing, mowing, or weeding is required. Landscape ordinances that require a percentage of the natural vegetation on a site be preserved are actually offering a bonus: an area of maintenance-free, value-rich landscaping. There can also be energy savings when the preservation of mature tree canopy provides shade to buildings, making them less expensive to heat and cool. Thompson and Sorvig write that "[e]xisting trees are among the most valuable features a site can have, from both ecological and real-estate perspectives…A well-maintained *mature* landscape is reported to increase the value of property by up to 75 percent" (2000, p47). When it comes to preserving native plant communities and limiting site

disturbance, Thompson and Sorvig grasp the heart of the matter: "It is impossible to protect what you don't respect. Even for professionals who have a strong love of nature, working on a site involves carefully setting priorities and, in many cases, reeducating clients and coworkers. Attitudes about preserving natural conditions have a strong influence on design and construction priorities. Is the desire for soccer practice at home worth flattening the backyard? Is the need to impress the neighbors enough justification for using extra resources, or removing native plants to install a conventional lawn? Choices like these are never easy and require thinking back to the basic attitudes about the human relationship to the landscape" (2000, p31). The human relationship to the landscape ought to be one of increasing understanding, especially when water conservation is at issue. While this strategy is included in model landscape ordinances primarily as means of reducing the amount of landscaped area that requires irrigation, there are clearly many other reasons to preserve natural areas.

Restoring Native Communities – As Wasowski writes, "A basic mistake most people make with regard to landscaping is to think of plants as individuals….In nature, plants do not really exist as individuals; they exist as part of communities" (2000, p30). Limiting disturbance on a site by preserving at least a portion of the natural vegetation provides numerous benefits, but even restoration of native habitat on a site using native plants saves money and energy; Wasowski writes that "the costs of installing and maintaining a natural landscape over a ten-year period could be one-fifth that of maintaining a traditional lawn-centered landscape" (2000,

p44). Native plants are species that are indigenous to Florida; that is, plants that are associated with and suited for the microclimate present, and which are generally assumed to be species that were in existence before European colonization of the United States. The FNAI defines a natural community as "a distinct and reoccurring assemblage of populations of plants, animals, fungi and microorganisms naturally associated with each other and their physical environment" (www.fnai.org/descriptions). For restoring native landscapes with native plants, the goal should be to create a self-sustaining natural landscape that will require irrigation for only the shortest establishment period possible by creating a Natural or low-water-use zone requiring temporary water demand. A restoration of a native plant community is designed according to the natural groupings of plants as they exist in native communities, and after establishment, it is expected that these areas will blend seamlessly with the surrounding environment and require no additional maintenance. This in itself is an unusual goal; conventional landscapes are generally thought of as requiring constant maintenance: irrigating, mulching, weeding, and mowing. Designing for native plant community restoration is like teaching a fledgling to fly on its own—an intrinsically natural approach. At the other end of the restoration spectrum is using native plants in conventional landscape design; although plants are not necessarily grouped by natural plant community type, the use of hydrozones creates a similar water need and microclimate grouping that still offers many native wildlife habitat and water-saving benefits.

Using Native Plants – Whether to use only native plants in a landscape is a hot topic in Florida today. It is universally agreed that the battle against exotic and invasive non-native plants is a critical ongoing struggle; the Florida Exotic Pest Plant Council is responsible for identifying and listing more than 125 plant species that need to be controlled or eradicated, such as Brazilian pepper, melaleuca, Australian pine, and many others. All revised landscape ordinance requirements in the state prohibit plants on this list; however, the native/non-native question is debated on the basis of practical, cultural, sustainable, and aesthetic considerations. One opinion is that using mostly natives with some non-natives still provides water-conserving plant selection benefits. Thompson and Sorvig write, "a growing number of professionals have found that landscapes based *primarily* on native species save water and other resources. This is not an argument for using natives *exclusively*…. nonnative species adapted to similar conditions are used in many regional gardens as specimens or accent plants" (2000, p123). Another opinion is that native plants are *better* suited than non-native or adapted plants for Florida's conditions, especially when choosing plants for water conservation, and thus using *only* native plants should be strongly encouraged and/or required. The Florida Native Plant Society (FNPS) and the Association of Florida Native Nurseries (AFNN) are two of the most well-known native plant advocacy organizations in the state. There are many local chapters and similar groups of native plant aficionados who maintain that native plants are the best choice for Florida's landscapes. Florida native plants are commonly referred to as "drought-tolerant," but this can be misleading.

The fact is that native plants have a range of water and cultural requirements, like all plants, although Florida natives are—by nature—suited to the extremes of Florida's climates. Many Florida natives have greater drought-tolerance and salt tolerance than natives in other regions of the U.S. While it is true that, historically, the use of non-native plants is responsible for bringing "many of the 400 species of invasive pants now threatening vast areas of U.S. ecosystems, the goal of sustainable plant selection and water-conserving landscape design is to reestablish "self-maintaining plant communities that conserve environmental resources" (Thompson & Sorvig, 2000, p125), and this can be accomplished with plants that are native to Florida as well as adapted to Florida's climate.

The second Design Resource created for this thesis project is the Natural Plant Community Guide, which includes an example of a Natural Plant Community Map, and Natural Plant Community Plant Lists. This resource is designed to support the second strategy used in water-conserving model landscape ordinances by contributing to the preservation of native vegetation, the restoration of native plant communities, and the use of the "right" native plants in the "right places." The Natural Plant Community Guide will be discussed further in Chapter Six.

Strategy 3: Limiting Turfgrass

The limitation of turfgrass, while not of central focus for this thesis project, is an important strategy for reducing water use in landscape design and irrigation. The fact is that turfgrass is a thirsty plant; water conservation experts agree that the lawn area uses more water and energy to maintain

than any other area of the landscape. Therefore, most Xeriscape manuals and water-saving measures suggest using turfgrass only in areas where there is an intended use: play areas, for example. The fourth principle of Xeriscape is "Use Turf Wisely" as a practical part of the landscape, so that the allotment of water to a turf area is kept to a reasonable amount. Even in residential landscapes where owners prefer the aesthetic appeal of a lawn, reducing the size of the lawn area and irrigating it separately from the rest of the landscaping can save a significant amount of water. The following tips are offered from the Sustainable Building Sourcebook (www.greenbuilder.com/sourcebook/XeriscapeGuideline): (1) Design turf in rounded, compact shapes in order to water and mow more efficiently; keep high maintenance turf areas close to the house and low maintenance areas farther away; (2) Design turf irrigation separately from other landscaped areas; (3) Choose turf that is appropriate to the location; St. Augustine grass, which is the choice for most Florida lawns, has poor drought and freeze tolerance and is best suited for shady areas. When St. Augustine is grown in areas of full sun, it consumes more water than any other available grass; it is, in fact, not the best choice for sunny Florida weather. Other grasses to try include Bahia, Bermuda, and Zoysia; (4) Finally, minimize turf areas by using alternatives, like native groundcovers, wildflowers, and grasses, or pervious materials like gravel.

Landscape Design Processes

Landscape ordinance requirements that stipulate the use of hydrozones to promote water conservation in landscape design expect more than water savings. The hydrozone requirement demands the use of the hydrozone concept, at the very least, as a new step in the design process, and at most, as a new conceptual basis for landscape design. Strategies for applying the hydrozone concept to landscape design demonstrate a variety of approaches; yet how does the hydrozone concept fit into design *process*? The following flowcharts, Figures 5-7 and 5-8, illustrate two general types of landscape design processes; the first is the Traditional Landscape Design Process, and the second is the Ecological Landscape Design Process. The point at which the Hydrozone Diagram is integrated into the design process is the main element that distinguishes the two flowcharts.

In the Traditional process, the Hydrozone Diagram is created as part of the Design Concept, after the Site Synthesis, Program, and User Analysis have been assimilated into an Ideal Functional Diagram and a Site-Related Functional Diagram. At this stage, the designer has created a layout of all the major elements on the site, and the Hydrozone Diagram is combined with this functional diagram as part of the Design Concept. It is at this stage that the hydrozone areas would be designated high-, medium-, and low-water use.

In the Ecological process, the Hydrozone Diagram is created along with the Site Synthesis, using the microclimates and other factors determined during the Site Inventory to designate areas for high-, medium-, and low-water use areas.

The Ecological Process places a greater emphasis on reading the landscape to choose the "right plant" for the "right place," while the Traditional Process tends to emphasize the importance of human use for hydrozone placement decisions. A combination of both approaches will ultimately result in a process that blends the "physical ecology of plants," or "ecological planting design," with the "human ecology of land use" for the best possible design. Some sites may lend themselves better than others to a reliance on the Traditional or the Ecological process. The flowcharts are intended to illustrate that when and how the designer creates the Hydrozone Diagram is what makes the hydrozone concept a useful and practical tool for water conservation as well as a fresh conceptual basis for guiding design decisions using the goals of resource conservation.

TRADITIONAL LANDSCAPE DESIGN PROCESS

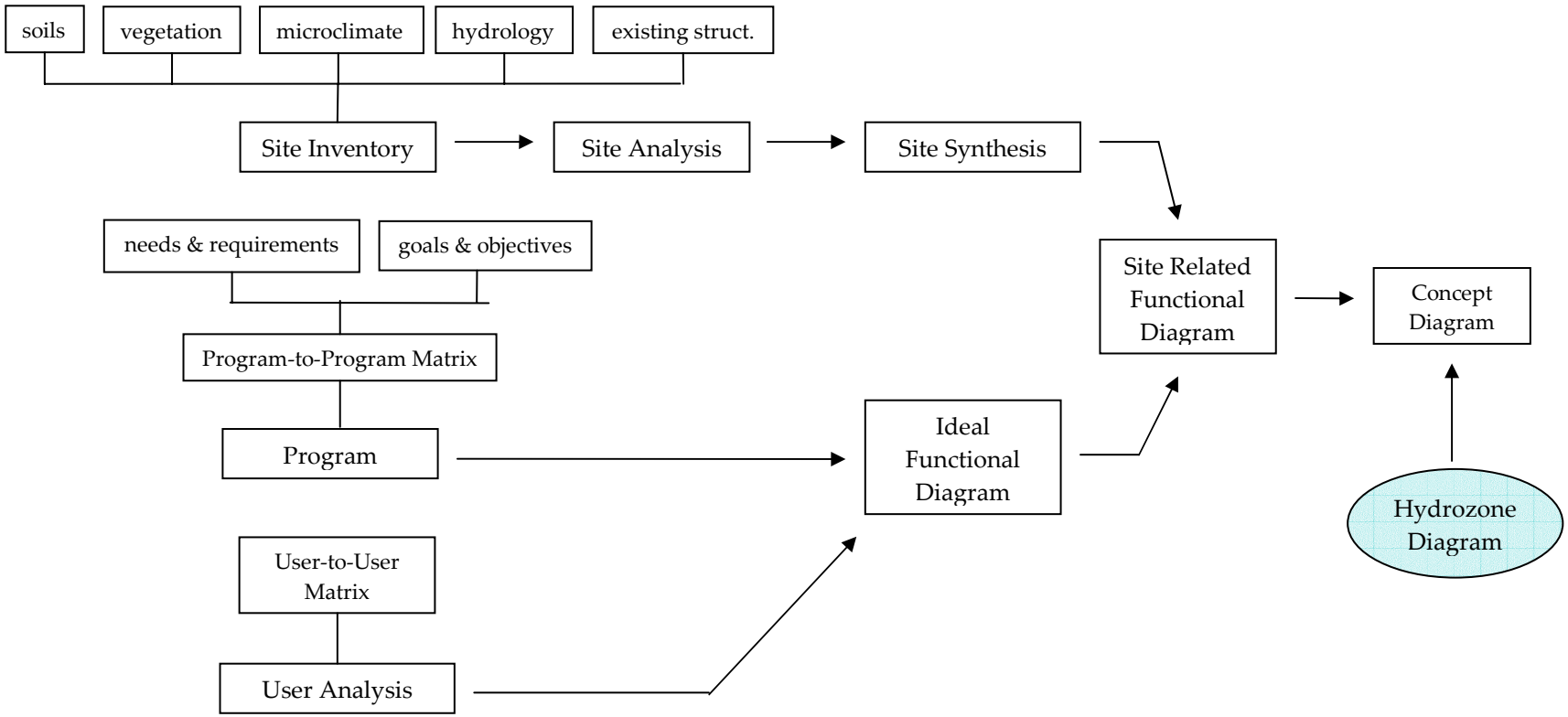


Figure 5-7. The Traditional Landscape Design Process. (author.)

ECOLOGICAL LANDSCAPE DESIGN PROCESS

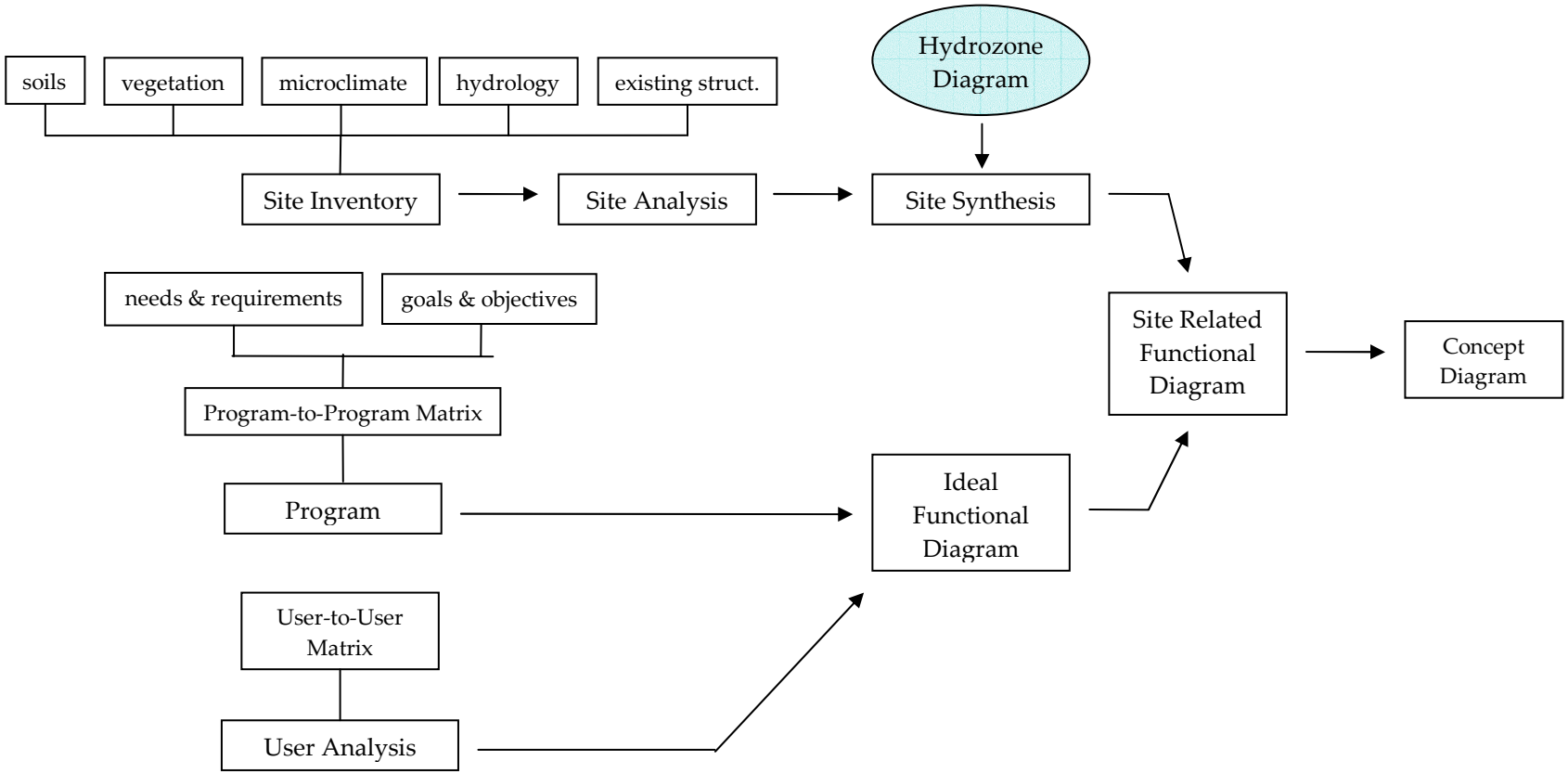


Figure 5-8. The Ecological Landscape Design Process. (author.)

The following illustrations from Colorado Springs Utilities demonstrate some of the steps in the Traditional Landscape Design Process, and where the Hydrozone Diagram fits into the process. Figure 5-9 shows a typical site analysis and synthesis (microclimates labeled "hot & dry," an area with a slope) that is already combined with the client's program (hide view of neighbors and keep view of mountains) and some elements of user analysis (backyard path and exit to basement). (While the following illustrations only demonstrate the Traditional Landscape Design Process, the Site Synthesis step, of which some elements are shown in Figure 5-9, is the stage in the Ecological Landscape Design Process when the Hydrozone Diagram would be determined.)

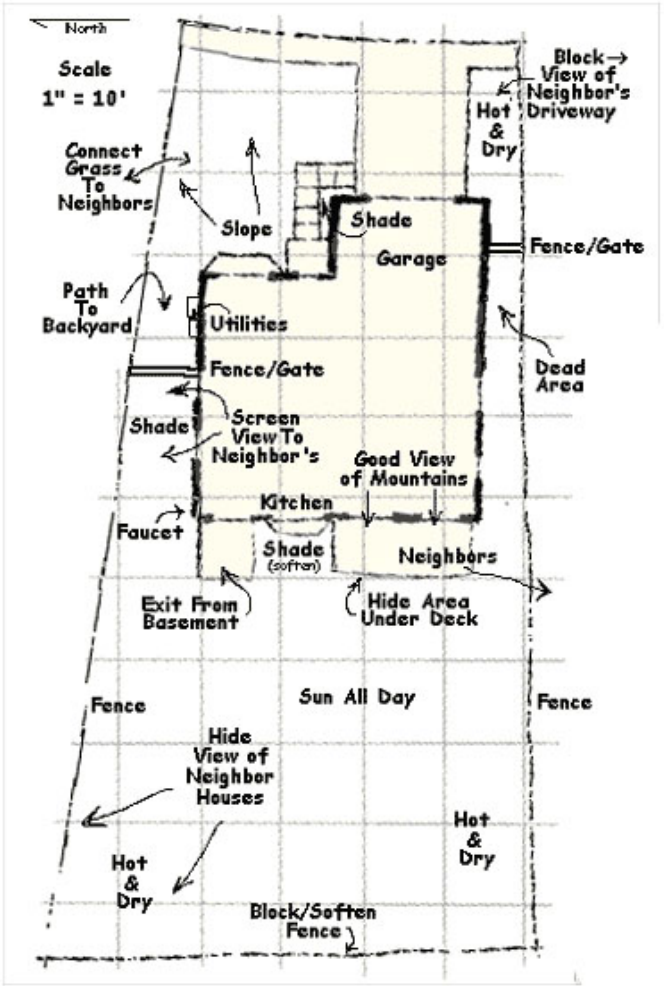


Figure 5-9. Site Synthesis/Program/User Analysis Illustration. Colorado Springs Utilities. www.csu.org/environment/conservation/xeriscape/resources.

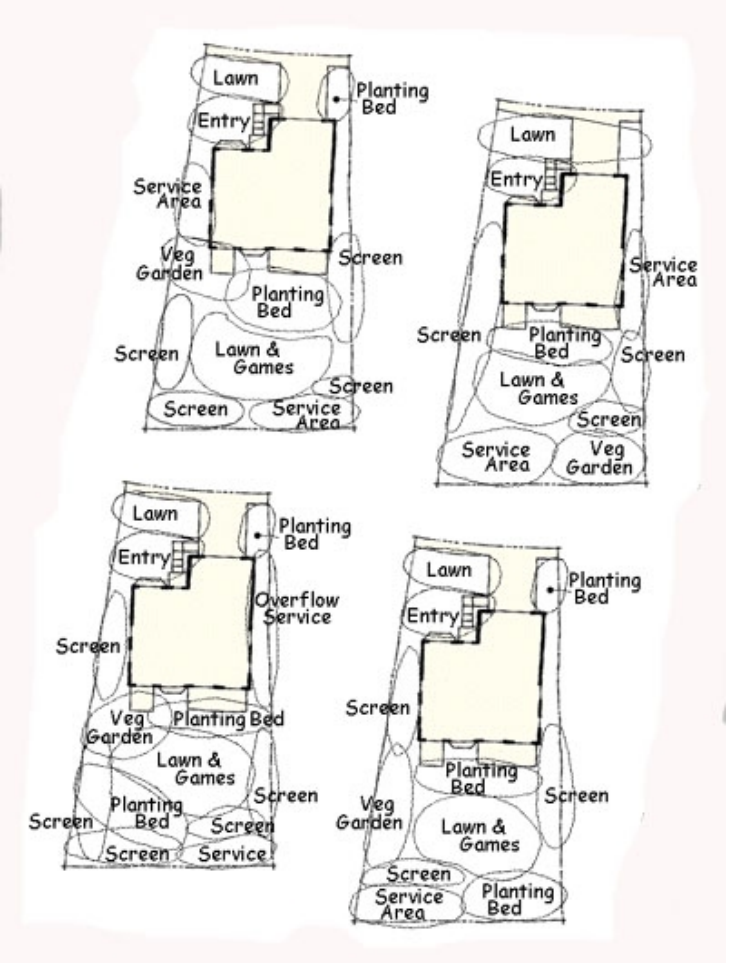


Figure 5-10. Site-Related Functional Diagrams. Colorado Springs Utilities. www.csu.org/environment/conservation/xeriscape/resources.

Following the Traditional process flowchart, Figure 5-10 shows a series of Site-Related Functional Diagrams that begin to lay out the various elements on the site.

The next step in the Traditional design process is to create a Hydrozone Diagram that relates to the Concept Diagram. Figure 5-11 shows the Hydrozone Diagram, which is based on the intended human use areas included in the program, and the microclimate areas identified in the site synthesis. The Hydrozone Diagram is labeled as High, Moderate, and Low water use areas. Figure 5-12 shows the Concept Diagram, with plant massing and placement shown in the colored hydrozone areas.

Figure 5-11. The Hydrozone Diagram. Colorado Springs Utilities. www.csu.org/environment/conservation/xeriscape/resources.

Figure 5-12. The Concept Diagram. Colorado Springs Utilities. www.csu.org/environment/conservation/xeriscape/resources.

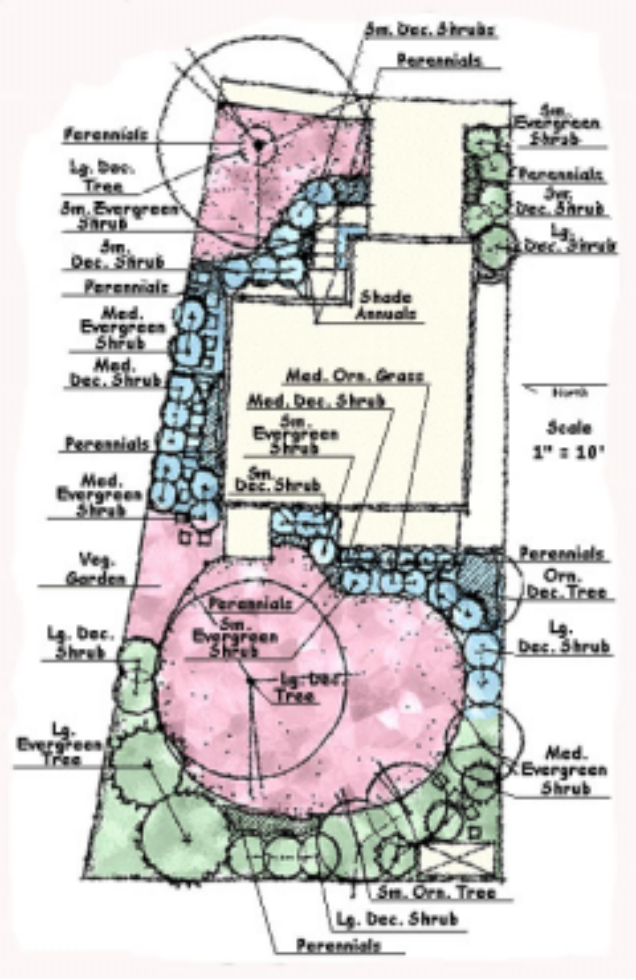


Figure 5-13. The Final Design Plan. Colorado Springs Utilities. www.csu.org/environment/conservation/xeriscape/resources.

The next illustration, shown in Figure 5-13, reveals the Final Design Plan, in which plants are labeled by size and type, still within their designated hydrozones. The final step would be to select plants that fit the requirements of each type (such as "Small Evergreen Shrub") and also fit within the appropriate level of water demand. This is the stage at which the first Design Resource, the Hydrozone Plant Selection Guide, becomes an important tool for fulfilling the hydrozone requirement of a model landscape ordinance. How does a designer know how much water a plant needs and in what microclimate conditions it will thrive? What are the available resources for plant selection? These issues will be discussed in Chapter Six.

Chapter Six: Design Resource Guides

Available Plant Selection References

Water-conserving landscape design is a critical challenge for designers to implement in all projects. In order to do so successfully, designers need useful tools and accurate information. All water-conserving landscape design references repeat the mantra of "right plant, right place," and the importance of grouping plants by water demand. Yet few provide any *efficient* means of determining a plant's water demand. Most experienced landscape architects and designers already know through years of practice (and doubtless some trial-and-error) which plants will thrive in high, medium, and low water use zones; however, one could argue that since landscape irrigation is generally accepted as commonplace perpetual plant maintenance, the site conditions that might otherwise force a designer to choose plants for best chances of survival can be altered enough through fertilizer, irrigation, and soil amendments that knowing a plant's water demand is not always necessary. For non-professionals, new designers, or those new to water-conserving landscape design, plant references that include information on plants' water demands are essential for applying the lessons of Xeriscape and the challenges of hydrozoning to landscape plans. There are a number of references available online or in books; when designing reference books for practical purposes, the importance of organization cannot be overstated. Typical Florida plant guidebooks, such as: Watkins and Sheehan's *Florida Landscape Plants, Revised Edition*; Nelson's *Florida's Best Native Landscape Plants*; Dehgan's *Landscape Plants for*

Subtropical Climates; and Osorio's *A Gardener's Guide to Florida's Native Plants*, all include water demand, soil preference, and light exposure information for each plant under the heading "Culture" or "Growing Conditions;" notably, Haehle and Brookwell's *Native Florida Plants* only includes light requirements, but Watkins and Sheehan include culture, light *and* soil requirements.

The organization of these guidebooks varies, but is usually based on plant names: Watkins and Sheehan organize by phylogeny, (following plant evolution from gymnosperms to angiosperms), grouped by family name. For those not well-versed in botany, finding a plant by scientific or common name requires a scan of the index. Dehgan's book is also organized by family name, but the table of contents is detailed and provides a list of plants, alphabetized by scientific name, included in each family. Nelson's guidebook is organized alphabetically by scientific name and contains thorough information on each plant; however, like the Watkins and Sheehan book and the Dehgan book, there is no way to browse a general category of "trees" or "shrubs." Although there is a "Species by Category" list at the beginning of Nelson's book, it does not include page numbers. (It is nevertheless an excellent reference when looking for information on a specific plant.) Both Osorio's and Haehle and Brookwell's reference books are organized by general categories: ferns, palms, large trees, small trees, shrubs, and so on. This kind of organization lends itself better to plant selection by "browsing;" for example, a designer might be looking for a deciduous spring-flowering tree that prefers a partly sunny area with well-drained soils in a microclimate designated as part of the Low Water Use Zone.

To search for plants that would be suitable for a particular water use zone using one of the available references, a designer would have to decide first which plants to use, then either search for each plant individually (by name) to determine its water use, or, if the designer had not decided which plants to use, browse a general category of plants, mentally removing from the lineup those with differing water needs. Both avenues are rather inefficient for discerning plants for particular hydrozone suitability.

There are some references that begin to simplify this process for designers. The first is Brandies's *Xeriscaping for Florida Homes* book, which includes a Plant Selection Guide in Appendix A. The charts are excerpted from booklets compiled by the Northwest Florida, St. Johns River, South Florida, and Southwest Florida Water Management Districts. Brandies makes reference to Xeriscape zone terminology in the "Key to Abbreviations" for the Plant Selection Guide: "'Moderately Drought Tolerant' plants (*) are appropriate for the drought tolerant zone. 'Very Drought Tolerant' plants (**) are appropriate for the natural zone. Other plants should be placed in the oasis zone" (1994, p137). Brandies's Plant Selection Guide is organized for browsing by categories: grasses, ground covers, shrubs, trees, and so on. Under each category, the chart is alphabetized by common name; because plants usually have many common names and only one scientific name, this can be an unreliable way to search for a plant. Despite that weakness, the chart's first far-left column, under the heading "Drought Tolerance," (before the common name, which is the second column), displays a * or a ** or is left blank. Running one finger down the left column allows the

designer to stop at * or ** and read the name and other cultural information about the plant to determine its suitability for the location in question. Brandies's organization improves upon the SJRWMD *Xeriscape™ Plant Guide* (1990) by including the scientific names of plants and moving the "Drought Tolerance" column from the fourth to the first column of consideration. The latest WMD Xeriscape Guide, *Waterwise Florida Landscapes: Landscaping to Promote Water Conservation Using the Principles of Xeriscape™* (2001) improves upon its predecessor with charts also organized by general category, and alphabetized by common name. Scientific names are included, but water demand, or "Soil Moisture Range," is still relegated to the fourth column. This Plant List is graphically very easy to read, with water-drop symbols differentiating a range of Wet, Moist, or Dry Soil Moisture preferences and sunshine-and-clouds symbols differentiating a range of light preferences: Full Sun, Partial Sun, and Shade. Unlike the reference guidebooks, Brandies's Plant Selection Guide and the Xeriscape guides produced by the WMDs provide quick-reference information, boiled down for efficient browsing.

A Hydrozone Diagram requires suitable plant selections to achieve the goals of water conservation. The model landscape ordinances that require hydrozones for landscape plan submittals do so in order to reduce the consumption of public water supply for landscape irrigation. The Design Resources created for this thesis project are intended to encourage landscape design with the hydrozone concept as a consistent practice using a new perspective—one that may become "second nature" as it catches on.

Design Resources

The following **Hydrozone Plant Selection Guide for Zone 9A** is the first of two suggested resources in support of the water conservation strategies described in the previous chapter. The **Hydrozone Plant Selection Guide** is a compilation of commonly used Florida-adapted and Florida native landscape plants from *Waterwise Florida Landscapes: Landscaping to Promote Water Conservation Using the Principles of Xeriscape,*™ from Florida's Water Management Districts, (2001 p20-63); the list does not include commonly prohibited plants or those that might be considered invasive exotics. The **Hydrozone Plant Selection Guide** is organized at three hierarchical levels; at the broadest level, it is organized by water demand: Wet, Moist, and Dry soil preferences. This is intended to give landscape designers who plan according to hydrozones a simpler method for approaching plant selection. These water demand types correspond to the three hydrozone types recommended in Xeriscape practices: Oasis, Drought-Tolerant, and Natural. The reason for using the terms Wet, Moist, and Dry for water demand is that the terms "drought-tolerant" and "natural" can be misleading for referencing plant types; some plants with water demand *preferences* for wet soils can still be considered "drought-tolerant;" for example, *Taxodium distichum*, Bald Cypress, prefers wet soils, but can also tolerate dry soils in some situations. Brandies notes that "[a] drought tolerant plant, by definition, is one that does not lose moisture at a high rate;" the important fact is that any plant suited for its Hardiness Zone can be "drought-tolerant" if it is "planted in the appropriate zone for its water

needs" (1994, p31). A plant's primary water demand (or soil moisture) preference was the basis for assigning each plant to a particular hydrozone; however, the Guide includes a Water Preference Range column for a more detailed view of the water needs of each plant. Grouping plants into overall water demand categories of Wet, Moist, and Dry can also indicate the general soil drainage characteristics that plants are likely to prefer. Plants in the "Wet" category might prefer poorly-drained soils; those in the "Moist" category might prefer moderately well-drained soils; and those in the "Dry" category might prefer well-drained soils. This is by no means a hard-and-fast rule; however, water demand can indicate soil drainage preference in a general sense. The **Hydrozone Plant Selection Guide** assumes the designer will begin plant selection with hydrozones, and thus, the organization of the Guide is customized to take the designer from the Hydrozone Diagram step in the design process to the Final Planting Plan with more ease than any quick-reference source currently available.

The second level of organization in the **Hydrozone Plant Selection Guide** contributes to the goal of better plant placement by sub-categorizing plants by Light Exposure needs: Full Sun, Part Sun, or Shade. Again, this category is supported with a column on each plant's Light Exposure Preference Range; this provides information on the range of light exposure a plant can thrive in. *The combination of a plant's water demand and Water Preference Range with its Light Exposure Preference Range will provide designers with a sound basis for determining the plant's appropriate placement in existing microclimate site conditions.* The third level of organization is

shown in the information columns that run across the top of the Guide; these provide additional information on characteristics of each plant: whether it is Evergreen or Deciduous, Annual or Perennial; whether its Salt Tolerance is High, Moderate, or Low; what its Mature Size is estimated to be; whether it is Native or Non-Native; and if it is a Native plant, in which Native Plant Communities it is commonly found. This final information column links the **Hydrozone Plant Selection Guide** resource to the second resource created for this thesis project: the **Natural Plant Community Guide for Pasco County**.

The **Natural Plant Community Guide** is a two-part resource: (1) sample **Natural Plant Community Maps** show the natural plant community types and native soil types; and (2) the **Natural Plant Community Plant Lists** categorize native plants according to the natural plant community types identified in the map legend. The maps are created using an existing Geographic Information Systems (GIS) dataset of vegetation land cover from the Florida Fish and Wildlife Conservation Commission that includes detailed descriptions for each plant community, as well as for disturbed and urbanized areas that can no longer be identified by native community. The **Natural Plant Community Guide** created for Pasco County is intended to assist designers in identifying the natural plant communities and native soil types at the neighborhood scale. The native plants in the **Natural Plant Community Plant Lists**, rather than being organized by water demand and light exposure, are categorized by plant community type; however, each plant's water demand and light exposure preference is also listed for cross-referencing to

the **Hydrozone Plant Selection Guide**. The **Natural Plant Community Guide** is useful for two primary reasons: (1) it can establish the value of an uncleared site within the context of its natural ecological community, thus helping a designer to preserve plant communities of highest ecological importance and to minimize disturbance throughout the project, and (2) for a disturbed infill site it identifies its historical ecological community, and thus offers an alternative to further disturbance with a roadmap for restoration. In addition, it is an educational tool for understanding plant selection as an exercise in "community" design for ecological restoration.

Together, the two resources designed by this thesis project, the **Hydrozone Plant Selection Guide** and the **Natural Plant Community Guide,** offer practical tools to support landscape architects and designers in creating sustainable projects that adhere to the "letter" of the laws and regulations in water-conserving landscape ordinances as well as the spirit in which they were adopted.

HYDROZONE PLANT SELECTION GUIDE

The plant list is adapted from *Waterwise Florida Landscapes: Landscaping to Promote Water Conservation Using the Principles of Xeriscape,*™ from Florida's Water Management Districts, 2001 p20-63. www.sfwmd.gov/newsr/plant_guide/plant_guide.htm.

KEY TO GUIDE:

Water Preference Range: W=Wet; M=Moist; D=Dry

Light Exposure Preference Range: FS=Full Sun; PS=Part Sun; S=Shade

Evergreen or Deciduous/Annual or Perennial: E=Evergreen; D=Deciduous; A=Annual; P=Perennial

Salt Tolerance: L=Low; M=Moderate; H=High

Mature Size: (spread) X (height) in feet

Native/Adapted: N=Native; A=Adapted (Adapted plants show " – " in the Native Plant Community field.)

Native Plant Community: *Upland Plant Communities*: (1) Coastal Uplands: CS=Coastal Strand; BD=Beach/Dune (2) Xeric Uplands: SF=Scrub Forest; SH=Sandhill (3) Mesic Uplands: HHF=Hardwood Hammock and Forest; PF=Pine Flatwoods

Wetland Plant Communities: (1) Palustrine (Freshwater Wetlands): FM=Freshwater Marsh; CyS=Cypress Swamp; HS=Hardwood Swamp; HH=Hydric Hammock (2) Marine & Estuarine: SM=Salt Marsh.

NOTE: Some plant entries show " · " in the Native Plant Community field. This indicates that the plant was not found in the main reference used for Natural Plant Community Plant Lists: the Central Florida lists in Jameson & Moyroud's *Xeric Landscaping with Florida Native Plants*, published by The Association of Florida Native Nurseries, 1991. The native plant communities for these entries can be found in other references; for the sake of consistency, only one reference was used here.

WATER DEMAND: WET		**Water Preference**	**Light Exposure Preference**	**Evgrn or Decid / Annl or Prnnl**	**Salt Tolerance**	**Mature Size**	**Native / Adapted**	**Native Plant Community**
Light Exposure: FULL SUN								
TREES								
Acer rubrum	Red Maple	W-D	FS-PS	D	L	30 x 60	N	HS/HH/CyS
Gordonia lasianthus	Loblolly Bay	W-M	FS-PS	E	L	15 x 60	N	HH
Magnolia virginiana	Sweetbay	W-M	FS-PS	E	L	60 x 90	N	HS/HH
Nyssa biflora	Blackgum	W-M	FS-PS	D	L	80	N	HS/CyS
Pinus taeda	Loblolly Pine	W-D	FS	E	L	25 x 100	N	PF/HH/HHF
Salix babylonica	Weeping Willow	W-M	FS	D	L	40 x 50	A	–
Taxodium distichum	Bald Cypress	W-D	FS-PS	E	H	25 x 80	N	CyS/HS
PALMS								
N/A								
SHRUBS								
Sambucus nigra subsp. canadensis	Elderberry	W	FS	E	L	15	N	FM
Tripsacum dactyloides	Eastern Gamagrass	W-M-D	FS	P	M	8	N	HH
GROUNDCOVERS/GRASSES								
Bacopa monnieri	Smooth Water-Hyssop	W	FS	n/a	H	0.5	N	SM
Distichlis spicata	Saltgrass	W-M	FS	n/a	H	1.5	N	SM/BS
Panicum hemitomon	Maidencane	W-M-D	FS	n/a	H	2	N	FM/
Paspalum vaginatum	Seashore Paspalum	W	FS	n/a	H	2	N	SM
Sisyrinchium angustifolium	Blue-Eyed Grass	W-M	FS	n/a		0.5	N	PF/SF
Spartina alternifolia	Smooth Cord Grass	W-M-D	FS	n/a	H	4	N	SM
Stachytorpheta jamaicensis	Blue Porterweed	W-M-D	FS-PS	n/a	H	1.5	N	–

VINES								
N/A								
FLOWERS								
Canna x generalis	Canna	W-M	FS-PS	P	L	5	A	–
Crinum americanum	Stringlily	W-M	FS-PS	P	L	3	N	FM/HS/HH
Light Exposure: PART SUN								
TREES								
Crataegus aestivolis	May Haw	O-DT	PS-FS	D	L	15 x 15	N	HH
Taxodium oscendens	Pond Cypress	O-DT	PS-FS	E	H	15 x 75	N	CYS/HS
PALMS								
N/A								
SHRUBS								
Cephalanthus occidentalis	Buttonbush	W-M	PS	D	L	15	N	FM/HS/HH
Clethra alnifolia	Sweet Pepperbush	W-M	PS-FS	D	L	20	N	PF
Cyrilla racemiflora	Titi	W-M	PS-FS	E		20	N	SF/HS
Hibiscus coccineus	Swamp Mallow	W-M	PS-FS		L	6-8'	N	FM/HS
Illicium floridanum	Florida Anise	W-M	PS-FS	E	L	15	N	–
Illicium parviflorum	Yellow Anise	W	PS	E	L	15	N	HH
Leucothoe racemosa	Swamp Doghobble	W	PS-FS	E		6	N	HH
Myrica cerifera	Wax Myrtle	W-M	PS-FS	E	H	20	N	CS/PF
Serenoa repens	Saw Palmetto	W-M-D	PS-FS	E	H	8	N	CS/PF
Viburnum obovatum	Walter's Viburnum	W-M	PS-FS	D	L	20	N	HH
GROUNDCOVERS/GRASSES								
Acrostichum danaeifolium	Giant Leather Fern	W-M	PS	n/a	H	8	N	SM/MS
Crinum americanum	String-Lily	W-M	PS	n/a	H	1.5	N	FM/HS/HH
Ilex vomitoria 'Shellings'	Dwarf Yaupon Holly	W-M-D	PS	E	H	2-5'	N	–

Muhlenbergia capillaris	Muhly Grass	W-M-D	PS	n/a	H	4	N	PF
Osmunda regalis	Royal Fern	W	PS-S	n/a	L	5	N	FM/HS/HH
Thelypteris kunthii	Southern Shield Fern	W-M	PS-S	n/a	L	2.5	N	HHF/HS/HH
VINES								
N/A								
FLOWERS								
Zephyranthes simpsonii	Rainlily	W-M	PS-FS	P	H	1	N	PF
Light Exposure: SHADE								
TREES								
N/A								
PALMS								
N/A								
SHRUBS								
N/A								
GROUNDCOVERS/GRASSES								
Blechnum serrulatum	Swamp Fern	W	S-PS	n/a	L	0.5	A	–
Hedychium coronanum	Butterfly Ginger	W-M	S-PS	P	M	5	A	–
Osmunda cinnamomea	Cinnamon Fern	W-M	S-PS	n/a		4	N	FM/HH
VINES								
N/A								
FLOWERS								
Saururus cernuus	Lizard's Tail	W-M	S	A	L	3	N	HS

WATER DEMAND: MOIST		Water Preference	Light Exposure Preference	Evrgrn or Decid / Annl or Prnnl	Salt Tolerance	Mature Size	Native / Adapted	Native Plant Community
Light Exposure: FULL SUN **TREES**								
Acer saccharum subsp. floridanum	Florida Sugar Maple	M-W	FS-PS	D	L	15 x 30	N	HHF
Betula nigra	River Birch	M-D	FS	D	L	25' x 50'	N	HH
Carya glabra	Pignut Hickory	M-D	FS	D	L	25' x 75'	N	HH/HHF
Castanea pumila	Chinquapin	M-D	FS-PS	D	M	15' x 40'	N	·
Catalpa bignoniodes	Catalpa/Indian Bean	M	FS-PS	D	L	35' x 40'	N	·
Celtis laevigata	Sugarberry	M	FS-PS	D	L	35' x 50'	N	CS/HH/HHF
Cercis canadensis	Redbud	M-D	FS-PS	D	L	15' x 25'	N	HHF
Citrus limon	Lemon	M	FS	E	L	15'	A	–
Citrus x paradisi	Grapefruit	M	FS	E	L	20'	A	–
Citrus x tangelo	Tangelo	M	FS	E	L	15'	–	–
Diospyros kaki	Japanese Persimmon	M	FS	D	M	25'	A	–
Ficus carica	Edible Fig	M	FS		L	12'	A	–
Ilex cassine	Dahoon Holly	M-W	FS-PS	E	M	10' x 50'	N	PF/CyS/HS/HH
Lagerstroemia indica	Crape Myrtle	M-D	FS	D	M	15' x 25'	A	–
Liquidambar styraciflua	Sweetgum	M-W-D	FS-PS	D	L	80'	N	HH/HHF
Liriodendron tulipifera	Tulip Tree	M	FS	D	L	35' x 90'	N	HH
Magnolia grandiflora	Southern Magnolia	M-D	FS-S	E	M	35' x 80'	N	CS/HH/HHF
Malus domesticus	Apple	M	FS		L	18' x 20'	A	–
Morus rubra	Red Mulberry	M	FS	D	M	30' x 70'	N	HH/HHF
Persea borbonia	Red Bay	M-D	FS-PS	E	H	35' x 50'	N	CS/HHF
Persea palustris	Swamp Bay	M-W	FS-PS	E	H	35' x 40'	N	PF/CyS/HS/HH
Platanus occidentalis	Sycamore	M	FS	D	M	70' x 100'	N	·

	Pyrus communis 'Hood'	Hood Pear	M-D	FS	D	L	20'	A	–
	Quercus laurifolia	Diamond-Leaf Oak	M-W	FS	E	L	45' x 80'	N	HH/HHF
	Quercus nigra	Water Oak	M-W	FS	E	L	50' x 80'	N	PF/HH/HHF
	Quercus shumardii	Shumard Oak	M-D	FS-PS	D	L	25' x 80'	N	HHF
	Rhamnus caroliniana	Carolina Buckthorn	M	FS			20' x 25'	N	·
	Sapindus marginatus	Florida Soapberry	M	FS		H	25' x 50'	N	HHF
	Ulmus alata	Winged Elm	M-W	FS-PS	D	L	5' x 40'	N	HH/HHF
	Ulmus americana	American Elm	M-D-W	FS-PS	D	L	30' x 40'	N	HH
	Viburnum rufidulum	Blackhaw Viburnum	M-D	FS-PS	D	L	15' x 20'	N	·
	PALMS								
	N/A								
	SHRUBS								
	Abelia x grandiflora	Glossy Abelia	M	FS		L	6	A	–
	Callistemon citrinus	Bottlebrush, Lemon	M	FS	E	M	20	A	–
	Callistemon rigidus	Bottlebrush, Stiff	M	FS	E	M	15	A	–
	Camellia sasanqua	Sasanqua Camellia	M	FS	E	L	15	A	–
	Gardenia augusta	Gardenia, Cape Jasmine	M	FS	E	L	6	A	–
	Hibiscus syriacus	Rose-of-Sharon	M	FS-PS	D	L	10	A	–
	Jasminum mesnyi	Primrose Jasmine	M	FS	E	L	8	A	–
	Juniperus chinensis	Chinese Juniper	M	FS	E	L	8	A	–
	Lagerstroemia indica	Crape Myrtle	M-D	FS	D	L	20	A	–
	Leucophyllum frutescens	Texas Sage	M	FS	E	M	5	A	–
	Malus angustifolia	Crabapple	M-D	FS		L	20	N	·
	Odontonema tubiforme	Firespike	M	FS	P	L	6	A	–
	Photinia glabra	Photinia, Red-Hip	M	FS	E	L	8	A	–
	Pyracantha coccinea	Firethorn, Red	M	FS	E	M	10-15'	A	–
	Rosa laevigata	Cherokee Rose	M	FS	E	L	10+	A	–

	Rubus 'Brazos'	Brazos Blackberry	M	FS		L	4	A	–
	Spiraea cantoniensis	Chinese Spirea	M	FS	D	L	5	A	–
	Vaccinium cultivars	Blueberry	M	FS	E	L	8	N	CS/SF/PF/HH
	Vitex agnus-castus	Chaste-Tree	M	FS	D	M	12	A	–
	GROUNDCOVERS/GRASSES								
	Andropogon virginicus var. glaucus	Broomsedge	M	FS	n/a	M	3-5'	N	PF
	Aristida beyrichiana	Wiregrass	M-D	FS	n/a		2-3'	N	·
	Fragaria chiloensis	Strawberry	M	FS	n/a	L	1	A	–
	Juniperus chinensis 'Pftizeriana'	Pftizer Juniper	M-D	FS	n/a	M	6	A	–
	Juniperus procumbens	Japanese Garden Juniper	M-D	FS	n/a	M	2	A	–
	Mimosa strigillosa	Powderpuff	M	FS	n/a		0.5	N	PF
	Miscanthus sinensis	Porcupine Grass	M-D	FS	n/a		6	A	–
	Pennisetum setaceum	Fountain Grass	M	FS	n/a	L	3	A	–
	Ruellia caroliniensis	Wild Petunia	M-D	FS	n/a	L	1-3'	N	HHF
	Sorghastrum secundum	Lopsided Indiangrass	M-D	FS	n/a	M	4	N	SH/PF
	VINES								
	Bignonia carpeolata	Crossvine	M-D	FS-PS	E	L		N	HHF/HH
	Passiflora x 'incense'	Incense Passion Flower	M-D	FS	E	L		A	–
	Vitis rotundiflora	Muscadine Grape	M	FS	D	L		N	·
	Vitis simpsoni labrusca	Lake Emerald Grape	M	FS	D	L		A	–
	Vitis smalliana labrusca	Blue Lake Grape	M	FS	D	L		A	–
	Wisteria frutescens	American Wisteria	M	FS	D	L		N	·
	FLOWERS								
	Achillea millefolium	Yarrow	M-D	FS	P	L	1.5	N	·
	Antirrhinum majus	Snapdragon	M	FS-PS	A		2	A	–

	Aster carolinianus	Climbing Aster	M-W	FS-PS	P	L	1.5	N	HS/HH
	Chrysanthemum morifolium	Chrysanthemum	M	FS-PS	P	L	3	A	–
	Conoclinum coelestinum	Mistflower	M-D	FS	P	L	2	N	HH
	Coreopsis leavenworthii	Common Tickweed	M	FS	P	L	5	N	·
	Crinum spp.	Crinum Lily	M	FS-PS		M	4	A	–
	Flaveria linearis	Yellowtop	M-D	FS	P	H	4	N	PF
	Gerbera jamesonii	Gerbera Daisy	M	FS-PS	P	L	1.5	A	–
	Helianthus angustifolia	Narrow-leaf Sunflower	M-W	FS	P	L	6	N	BD/PF
	Hippeastrum hybrids	Amaryllis	M	FS-PS	P	M	2	A	–
	Iris spp.	Iris	M-W	FS-PS	P	L	2	A	–
	Iris virginica	Virginia Iris	M-W	FS	P	L	3	N	·
	Liatris spicata	Blazing Star	M-D	FS-PS	P	L	3	N	SF/PF
	Lobelia cardinalis	Cardinal Flower	M-W	FS-PS	P	L	3	N	PF/HH
	Lobularia maritima	Sweet Alyssum	M	FS-PS	P	L	1	A	–
	Mirabilis jalopa	Four O'Clock	M-D	FS-PS	P	L	2	A	–
	Narcissus tazetta	Cream Narcissus	M	FS	P	L	1.5	A	–
	Pelargonium x hortorum	Geranium	M-D	FS-PS	A	L	2	A	–
	Petunia x hybrida	Petunia	M	FS	A	L	1.5	A	–
	Phlox subulata	Phlox	M-D	FS	P	L	3	A	–
	Rudbeckia hirta	Black-Eyed Susan	M	FS	A		3	N	PF
	Salvia spp.	Sage	M-D	FS	P	L	2-5'	A	–
	Salvia lyrata	Lyre-Leaf Sage	M-D	FS-PS	P	L	1.5	N	PF/HHF
	Salvia splendens	Scarlet Sage	M	FS-PS	A	L	2	A	–
	Solidago sempervirens	Seaside Goldenrod	M-D	FS	P	H	6	N	SM
	Stokesia laevis	Stokes Aster	M-D	FS-PS	P	M	1	N	·
	Strelitzia reginae	Bird-of-Paradise	M	FS-PS	P	L	4	A	–
	Tagetes lucida	Sweet Marigold	M	FS	A	L	3	A	–

	Tagetes patula	French Marigold	M	FS	A	L	2	A	–
	Torenia fourrieri	Wishbone Flower	M	FS-PS	A		1	A	–
	Trichostema dichotomum	Blue Curls	M-D	FS	A	H	2	N	·
	Verbena x hybrida	Verbena	M	FS	P	L	1.5	A	–
	Viola soronia	Florida Violet	M	FS-PS	P	L	0.5	N	HHF/HH
	Light Exposure: PART SUN								
	TREES								
	Aesculus pavia	Red Buckeye	M-W	PS	D	L	15' x 25'	N	HH/HHF
	Chionanthus virginicus	Fringe Tree	M-D	PS-FS	D	L	10' x 25'	N	HH/HHF
	Crataegus flava	Summer Haw	M	PS-FS	D		15'	N	SH
	Ilex ambigua	Carolina Holly	M-D	PS-FS	E		15'	N	·
	Prunus angustifolia	Chickasaw Plum	M	PS-FS	D	H	15' x 25'	N	SH
	Prunus caroliniana	Cherry Laurel	M	PS-FS	E	M	35'	N	HHF
	Prunus umbellata	Flatwoods Plum	M	PS-FS	D	L	10' x 25'	N	HHF
	Quercus michauxii	Swamp Chestnut Oak	M	PS-FS	D	L	35' x 80'	N	HHF/HH
	Tilia americana	Basswood	M	PS-FS	D	L	35' x 80'	N	HHF/HH
	Ulmus parvifolia	Chinese Elm	M	PS-FS	D	L	35' x 65'	A	–
	Zanthoxylum clava-herculis	Hercules's Club	M-D	PS-FS	D	H	15' x 45'	N	CS
	PALMS								
	Livistona chinensis	Chinese Fan Palm	M-D	PS	E		25	A	–
	Strelitzia nicoloi	Bird of Paradise Tree	M	PS	E	L	20	A	–
	SHRUBS								
	Berberis juliane	Wintergreen Barberry	M	PS	E	M	5	A	–
	Berberis thunbergii 'Atropurpurea Nana'	Crimson Pygmy Barberry	M	PS	D	M	4		
	Callicarpa americana	American Beautyberry	M-D	PS	D	L	6-9'	N	CS/HHF

	Cocculus laurifolius	Snailseed	M	PS-FS	E	L	13	A	–
	Dodonea viscosa	Varnishleaf	M-D	PS-FS	E	H	6	N	BD
	Dracaena spp.	Dracaena	M-D	PS	E	L	2-15'	A	–
	Erythrina herbacea	Coral Bean	M-D	PS-FS	E	M	15	N	BD
	Feijoa sellowiana	Pineapple Guava	M-D	PS-FS	E	M	14	A	–
	Halesia carolina	Carolina Silverbell	M	PS	D	L	25	N	·
	Hydrangea macrophylla	French Hydrangea	M	PS-FS	D	L	5	A	–
	Ilex crenata	Japanese Holly	M	PS-FS	E	L	6	A	–
	Ilex glabra	Gallberry	M	PS-FS	E	M	8	N	PF
	Ilex vomitoria 'Nana'	Dwarf Yaupon Holly	M-D	PS-FS	E	L	5	N	·
	Illicium anisatum	Anise Tree	M	PS	E	L	20	A	–
	Itea virginica	Virginia Sweetspire	M-W	PS-FS	E	L	7	N	HS
	Mahonia fortunei	Oregon Grape-Holly	M	PS-FS	E	M	5	A	–
	Osmanthus fragrans	Sweet Olive	M	PS	E	L	20	A	–
	Philadelphus coronarius	Mock Orange	M	PS-FS	D	L	12	A	–
	Platycladus orientalis	Arborvitae	M	PS	E	L	20	A	–
	Podocarpus macrophyllus	Podocarpus	M	PS-FS	E	M	35	A	–
	Rhaphiolepis indica	Indian Hawthorn	M	PS	E	M	5	A	–
	Rhododendron spp.	Azalea hybrids	M	PS	E	L	10	A	–
	Rhododendron austrinum	Florida Flame Azalea	M	PS	D	L	6	N	·
	Rhododendron canescens	Pinxter Azalea	M	PS	D	L	10	N	HHF
	Rhododendron minus var. chapmanii	Chapman's Azalea	M	PS-S	E	L	5	N	·
	Vaccinium corymbosum	Highbush Blueberry	M-D	PS-FS	E	M	10	N	HH
	Vaccinium myrsinites	Shiny Blueberry	M-D	PS	E	L	2	N	SF/PF
	Viburnum odoratissimum	Sweet Viburnum	M	PS-FS	E	L	8	A	–

	Viburnum suspensum	Sandankwa Viburnum	M	PS-FS	E	L	6	A	–
	Zanthoxylum clava-herculis	Hercules's Club	M-D	PS-FS	D	M	30	N	CS
	GROUNDCOVERS/GRASSES								
	Hymenocallis latifolia	Mangrove Spiderlily	M-W	PS	n/a		3	N	BD
	Stenotaphrum secundatum	St. Augustine Grass	M-D	PS-FS	n/a		0.5	A	–
	Trachelospermum asiaticum	Dwarf Confederate Jasmine	M	PS-FS	E	M	0.5	A	–
	Tradescantia pallida	Purple Queen	M-D	PS-FS	n/a	H	1	A	–
	Zoysia japonica	Zoysiagrass	M-D	PS-FS	n/a	H	0.5	A	–
	VINES								
	Campsis radicans	Trumpet Vine	M-D	PS-FS	D	L		N	HH
	Gelsemium sempervirens	Yellow Jessamine	M-D	PS-FS	E	L		N	SH/HHF/PF
	Lonicera sempervirens	Coral Honeysuckle	M-D	PS-FS	E	M		N	SH/HHF
	Parthenocissus quinquefolia	Virginia Creeper	M-D	PS-FS	D	L		N	PF
	FLOWERS								
	Ageratum houstonianum	Ageratum	M-D	PS-FS			1	A	–
	Begonia x semperflorens-culturum	Wax Begonia	M-D	PS-FS		L	1	A	–
	Canna flaccida	Yellow Canna	M-W	PS-FS	P	L	4	N	FM
	Chrysanthemum x superbum	Shasta Daisy	M	PS-FS	A	L	2	A	–
	Impatiens spp.	Impatiens	M	PS	A	L	2	A	–
	Iris hexagona	Blue Flag Iris	M	PS-FS	P	L	3	N	FM/HS

	Zephyranthes atamasco	Atamasco Lily	M-W	PS-FS	P	H	2	N	PF
	Light Exposure: SHADE								
	TREES								
	Carpinus caroliniana	Hornbeam / American Ironwood	M-W	S-PS	D	L	15X50	N	HH/HHF
	Cornus florida	Florida Dogwood	M-D	S-PS-FS	D	L	20X25	N	HHF/
	Ostrya virginiana	Eastern Hop Hornbeam	M-D	S-PS-FS	D	L	40	N	HHF
	PALMS								
	Rhapidophyllum hystrix	Needle Palm	M	S-PS	E	M	5	A	–
	SHRUBS								
	Agarista populifolia	Pipestem	M-W	S-PS	E		10	N	HH
	Calycanthus floridus	Sweetshrub	M	S-PS	D	L	10	N	·
	Rapanea punctuata	Myrsine	M	S-PS	E	H	15	N	·
	Zamia pumila	Coontie	M-D	S-PS-FS	E	H	2	N	CS/SF/HHF/PF
	GROUNDCOVERS/GRASSES								
	Caladium x hortulanum	Fancyleaved Caladium	M	S-PS	n/a	L	1.5	A	–
	Cyrtomium falcatum	Holly Fern	M	S-PS	n/a	M	1.5	A	–
	VINES								
	N/A								
	FLOWERS								
	Spigelia marilandica	Woodland Pinkroot	M	S-PS	P	L	2	N	·

WATER DEMAND: DRY		**Water Preference**	**Light Exposure Preference**	**Evrgrn or Decid / Annl or Prnnl**	**Salt Tolerance**	**Mature Size**	**Native / Adapted**	**Native Plant Community**
Light Exposure: FULL SUN								
TREES								
Carya allna	Mockernut Hickory	D-M	FS-PS	D	L	35' x 60'	N	·
Carya floridana	Scrub Hickory	D	FS	D	L	25'	N	SF
Carya illinoiensis	Pecan	D	FS	D	L	50'	A	–
Diospyros virginiana	Common Persimmon	D-M	FS-PS	D	L	15' x 50'	N	CS/SH/PF/HHF
Ilex x attenuata 'East Palatka'	East Palatka Holly	D-M	FS-PS	E	M	10' x 30'	N	·
Juniperus silicicola	Southern Red Cedar	D-M	FS	E	H	25' x 60'	N	CS/HHF
Machura pomifera	Osage Orange	D	FS	D	M	25' x 50'	A	–
Parkinsonia aculeata	Jerusalem Thorn	D	FS	D	H	15' x 25'	A	–
Persea humilis	Silk Bay	D	FS	E	M	30'	N	SF
Pinus clausa	Sand Pine	D	FS-PS	E	L	25' x 30'	N	SF
Pinus elliottii	Slash Pine	D-M	FS	E	M	25' x 120'	N	SH/PF
Pinus palustris	Longleaf Pine	D-M	FS	E	L	35' x 90'	N	SH/PF
Pyrus colleryana	Bradford Pear	D-M	FS	E	H	20' x 30'	A	–
Quercus chapmanii	Chapman Oak	D	FS	D	M	20'	N	SF
Quercus geminata	Sand Live Oak	D	FS-PS	E	H	20' x 40'	N	CS/SF/SH
Quercus hemisphaerica	Laurel Oak	D-M	FS-PS	E	L	40' x 80'	N	HHF
Quercus incana	Bluejack Oak	D	FS	D	L	20' x 35'	N	SH
Quercus laevis	Turkey Oak	D-M	FS	D	M	20' x 50'	N	SH
Quercus myrtifolia	Myrtle Oak	D	FS	E	M	15' x 35'	N	CS/SF
Quercus virginiana	Live Oak	D-M	FS	E	M	40' x 60'	N	CS/PF/HHF
Sassafras albidum	Sassafras	D	FS-PS	D	L	20' x 45'	N	·
PALMS								
Chamaerops humilis	European Fan Palm	D-M	FS-PS	E	M	10	A	–

	Cycas revoluta	King Sago	D-M	FS-PS	E	L	8	A	–
	Dioon edule	Dioon Cycad	D	FS	E	L	10	A	–
	Phoenix canariensis	Canary Island Date Palm	D-M	FS-PS	E	M	40'	A	–
	Phoenix sylvestris	Wild Date Palm	D	FS	E	M	40'	A	–
	Sabal palmetto	Cabbage Palm	D-M-W	FS-PS	E	H	40'	N	CS/HHF/PF/CyS/HH
	Serenoa repens	Saw Palmetto	D-M-W	FS-PS	E	H	6'	N	CS/BD/SF/SH/PF
	Washingtonia robusta	Washington Palm	D-M	FS	E	M	80'	A	–
	Yucca aloifolia	Spanish Bayonet	D	FS-PS	E	H	15'	N	BD
	SHRUBS								
	Agave americana	Century Plant	D	FS	E	H	6+	A	–
	Bumelia tenax	Tough Buckthorn	D	FS	E	H	20	N	CS/SF
	Conradina canescens	Wild Rosemary	D	FS	E	M	4	N	SF
	Garberia heterophylla	Garberia	D	FS	E	?	6	N	SF/SH
	Hypericum reductum	St. John's Wort	D	FS	E	?	1	A	–
	Iva imbricata	Beach Elder	D	FS	P	H	3	N	BD
	Lyonia ferruginea	Rusty Lyonia	D	FS	E	L	15	N	SF/SH/PF
	Malvaviscus arboreus	Turk's Cap	D	FS	E	L	7	A	–
	Nerium oleander	Oleander	D	FS	E	H	15	A	–
	Rosmarinus officinalis	Rosemary	D	FS		H	3	A	–
	Severinia buxifolia	Boxthorn	D	FS	E	M	6	A	–
	Thymus vulgaris	Thyme	D	FS		L	1	A	–
	Vaccinium darrowii	Evergreen Blueberry	D	FS	E	L	2	N	SF/PF
	Ximenia americana	Tallow-wood	D	FS	E	L	8	N	SF
	Yucca aloifolia	Spanish Bayonet	D	FS	E	H	14	N	BD
	Yucca filamentosa	Adam's Needle	D	FS	E	L	6	N	SF/SH
	GROUNDCOVERS/GRASSES								
	Cynodon dactylon	Bermudagrass	D	FS	n/a	H	0.5	A	–

Eragrostis spectabilis	Purple Lovegrass	D-M-W	FS	n/a	L	2.5	N	SM
Helianthus debilis	Beach Sunflower	D-M	FS	n/a	H	1.5	N	BD/PF
Hemerocallis hybrids	Daylily	D-M	FS	n/a	H	2	A	–
Hypericum reductum	St. John's Wort	D	FS	E	H	1.5	N	SF/PF
Ipomoea imperati	Beach Morning-Glory	D	FS	n/a	M	0.5	N	CS/BD/HS
Ipomoea pes-caprae	Railroad Vine	D	FS	n/a	H	0.5	N	CS/BD/HS
Juniperus chinensis 'Parsonii'	Parson Juniper	D-M	FS	n/a	M	2	A	–
Juniperus conferta	Shore Juniper	D-M	FS	n/a	H	2	A	–
Licania michauxii	Gopher Apple	D	FS	E	H	1	N	BD/SF/SH/PF
Panicum amarum	Bitter Panicgrass	D	FS	n/a	H	3.5	N	BD
Paspalum notatum	Bahiagrass	D-M	FS	n/a		2	A	–
Sesuvium portulacastrum	Sea Purslane	D	FS	n/a	H	1-3'	N	BD/SM
Spartina bakeri	Sand Cordgrass	D-M-W	FS	n/a	H	3-6'	N	FM/SM
Spartina patens	Saltmeadow Cordgrass	D-M-W	FS	n/a	M	2	N	BD/SM
Sporobolus virginicus	Seashore Dropseed	D-M-W	FS	n/a	H	1	N	BD/SM
Uniola paniculata	Sea Oats	D	FS	n/a	H	4	N	BD
Yucca filamentosa	Adam's Needle	D	FS	n/a	M	3	N	SF/SH
VINES								
Passiflora incarnata	Passionflower	D-M	FS-PS	D	L		N	BD/SH
FLOWERS								
Asclepias tuberosa	Butterfly Weed	D-M	FS-PS	P	M	2	N	PF/SH/SF
Beriandiera subacaulis	Green Eyes	D	FS	P	L	1.5	N	·
Borrichia frutescens	Sea Oxeye Daisy	D-M	FS	P	H	3	N	BD/MS
Carphephorus corymbosus	Paintbrush	D	FS	P	L	4	N	SH/PF
Celosia argentea	Cockscomb	D-M	FS	A	L	2	A	–
Coreopsis tinctoria	Coreopsis	D-M	FS	P	L	3	A	–
Cosmos bipinnatus	Cosmos	D	FS	A	L	4	A	–

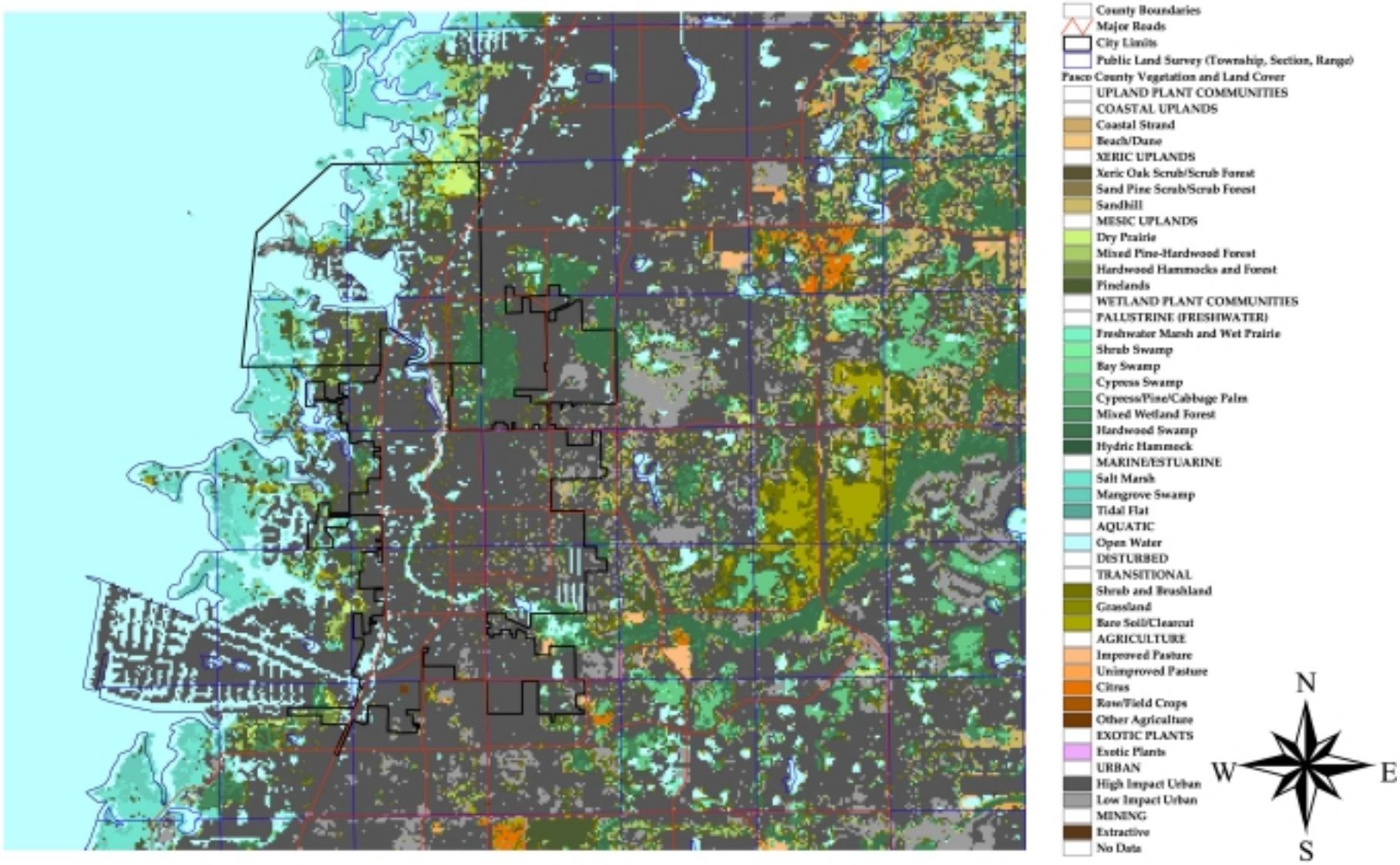
Cuphea micropetala	Cigar Plant	D	FS	P	L	3	A	–
Dyschoriste oblongifolia	Blue Twinflower	D	FS	P	L	0.5	N	PF
Echinacea purpurea	Purple Coneflower	D-M	FS	P	M	2	N	·
Eryngium yuccifolium	Rattlesnake Master	D-M	FS	P	L	3	N	·
Gaillardia pulchella	Blanketflower	D	FS	A/P	H	2	N	BD
Gamphrena globosa	Globe Amaranth	D-M	FS	A	L	2	A	–
Glandularia pulchella	Moss Verbena	D-M	FS	A	L	0.5	A	–
Helianthus debilis	Beach Sunflower	D	FS	P	H	1.5	N	BD
Heliotropium angiospermum	Scorpion Tail	D	FS	P	?	3	N	·
Hymenocallis latifolia	Spiderlily	D-M	FS	P	H	3	N	BD
Lantana montevidensis	Lantana	D	FS	P/E	H	2	A	–
Monarda punctata	Dotted Horsemint	D-M	FS	P	H	4	N	PF
Penstemon multiflorus	White Beardtongue	D	FS	P	L	3	N	·
Pentas lanceolata	Pentas	D-M	FS-PS	P	L	4	A	–
Phlox drummondii	Annual Garden Phlox	D-M	FS-PS	A	L	0.5	A	–
Portulaca grandiflora	Moss Rose	D-M	FS	A	M	0.5	A	–
Ruellia caroliniensis	Wild Petunia	D-M	FS-PS		L	1.5	N	HHF
Salvia coccinea	Tropical Red Sage	D-M	FS	P	M	2	N	BD
Senecio cineraria	Dusty Miller	D-M	FS-PS	A	L	1	A	–
Tropaeolum majus	Nasturtium	D	FS	A	L	1	A	–
Light Exposure: PART SUN								
TREES								
Ilex opaca	American Holly	D-M	PS-FS	E	M	15' x 45'	N	CS/HHF
PALMS								
Butia capitata	Pindo Palm	D	PS-FS	E	M	15'	A	–
Sabal etonia	Scrub Palmetto	D	PS	E	M	4'	N	SF
Sabal minor	Dwarf Palmetto	D-M	PS-FS	E	M	6'	N	HHF/HH

Trachycarpus fortunei	Windmill Palm	D	PS-FS	E	M	25'	A	–
SHRUBS								
Hydrangea quercifolia	Oakleaf Hydrangea	D-M	PS-FS	D	L	8	N	·
Lycium carolinianum	Christmas Berry	D	PS-FS	E	H	7	N	SM/MS
GROUNDCOVERS/GRASSES								
Agapanthus africanus	Agapanthus	D-M	PS	n/a	L	2	A	–
Cortaderia selloana	Pampas Grass	D-M	PS-FS	n/a	M	6	A	–
Liriope spp.	Lilyturf	D-M	PS	n/a	M	1	A	–
VINES								
Clerodendrum thomsoniae	Bleeding Heart	D-M	PS-FS	E	L		A	–
FLOWERS								
Costus barbatus	Spiral Ginger	D-M	PS	P	M	5	A	–
Dianthus barbatus	Sweet William	D-M	PS-FS	A	L	1.5	A	–
Pityopsis graminifolia	Golden Aster	D-M	PS-FS	P	L	3	N	SF/PF
Verbena bonariensis	Purpletop Verbena	D	PS-FS	P	L	4	A	–
Light Exposure: SHADE								
TREES								
Ilex vomitoria	Yaupon Holly	D-M-W	S-PS-FS	E	H	15' x 20'	N	CS/HHF
PALMS								
N/A								
SHRUBS								
N/A								
GROUNDCOVERS/GRASSES								
Aspidistra elatior	Cast Iron Plant	D-M	S-PS	n/a	M	2	A	–
Hedera canariensis	Algerian Ivy	D-M	S-PS	n/a	M		A	–
Hedera helix	English Ivy	D-M	S-PS	n/a	M		A	–
Ophiopogon japonicus	Mondo Grass	D-M	S-PS	n/a	M	0.5	A	–
Zamia pumila	Coontie	D-M	S-PS-FS	n/a	H	2	N	CS/SF/HHF/PF

	VINES								
	N/A								
	FLOWERS								
	Aquilegia canadensis	Wild Columbine	D-M	S-PS	P	L	3	N	·

NATURAL COMMUNITIES GUIDE: CITY MAP EXAMPLE

New Port Richey Natural Communities City Map



NATURAL COMMUNITIES GUIDE: PLANT COMMUNITIES LISTS

The following lists were compiled from the Central Florida plant lists in Jameson & Moyroud's *Xeric Landscaping with Florida Native Plants*, published by the Association of Florida Native Nurseries, 1991. The Water Demand/Light Needs column cross-references the ***main*** categories of the Hydrozone Plant Selection Guide; for water and light preference ***ranges,*** refer to each plant entry in the Hydrozone Plant Selection Guide. Some plant entries from Jameson & Moyroud are not listed in the Hydrozone Plant Selection Guide; for those entries, the Water Demand and Light Needs information (in blue print) is derived from Nelson's *Florida's Best Native Landscape Plants: 200 Readily Available Species for Homeowners and Professionals,* published in 2003 by the University Press of Florida. Plant entries not found in the Hydrozone Plant Selection Guide or in Nelson's book are marked with "·" in the Water Demand/Light Needs column. This information can be found in other sources; for the sake of consistency, only two references are used for the Natural Plant Community Plant Lists.

Natural Plant Communities Lists

Upland Plant Communities

Coastal Uplands

Coastal Strand

		Water Demand / Light Needs
Canopy Trees		
Celtis laevigata	Sugarberry	M/FS
Diospyros virginiana	Persimmon	D/FS
Juniperus silicicola	Southern Red Cedar	D/FS
Magnolia grandiflora	Southern Magnolia	M/FS
Persea borbonia	Redbay	M/FS
Quercus geminata	Sand Live Oak	D/FS
Quercus virginiana	Live Oak	D/FS
Sabal Palmetto	Cabbage Palm	D/FS
Understory Trees		
Forestiera segregata	Florida Privet	M/PS
Ilex opaca	American Holly	D/FS
Osmanthus americana	Devilwood	.
Quercus myrtifolia	Myrtle Oak	D/FS
Zanthoxylum clava-herculis	Hercules Club	M/FS
Zanthoxylum fagara	Wild Lime	D/FS
Shrubs		
Ardisia escallonoides	Marlberry	D/PS
Bumelia tenax	Tough Bumelia	D/FS
Callicarpa americana	Beautyberry	M/PS
Capparis cynophallophora	Jamaica Caper	D/FS
Eugenia axillaris	White Stopper	D/FS
Eugenia foetida	Spanish Stopper	D/FS
Forestiera segregata	Florida Privet	M/PS
Ilex vomitoria	Yaupon Holly	D/S-M/PS
Myrcianthes fragrans	Simpson Stopper	D/FS
Myrica cerifera	Wax Myrtle	W/FS
Myrsine guianensis	Myrsine	.
Psychotria nervosa	Wild Coffee	M/FS
Vaccinium arboreum	Sparkleberry	M/FS
Serenoa repens	Saw Palmetto	D/FS
Groundcovers		
Zamia pumila	Coontie	D-M/FS-S
Vines		
Echites umbellata	Devil's Potato	.
Ipomoea spp.	Morning Glory	D/FS
Parthenocissus quiquefolia	Virginia Creeper	M/FS
Vitis spp.	Wild Grape	M/FS
Wildflowers		
N/A		

Beach/Dune

Canopy Trees		
N/A		
Understory Trees		
N/A		
Shrubs		
Chrysobalanus icaco	Cocoplum	M/FS
Croton punctatus	Beach Croton	M/FS

Dodonea viscosa	Varnishleaf	M/FS
Erythrina herbacea	Coralbean	M/FS
Foresteria segregata	Florida Privet	M/FS
Myrcianthes fragrans	Simpson Stopper	D/FS
Serenoa repens	Saw Palmetto	D/FS
Sophora tomentosa	Necklace Pod	D/FS
Suriana maritima	Bay Cedar	D/FS
Yucca aloifolia	Spanish Bayonet	D/FS
Groundcovers		
Alternanthera maritima	Chaff-Flower	·
Alternanthera ramosissima	Chaff-Flower	·
Ambrosia hispida	Coastal Ragweed	·
Blutaparon vermiculare	Samphfire	·
Chamaesyce spp.	Dune Spurge	·
Distichlis spicata	Golden Creeper	W/FS
Hymenocallis latifolia	Spider Lily	D-M/FS-PS
Ipomoea pes-caprae	Railroad Vine	D/FS
Ipomoea stolonifera	Beach Morning Glory	D/FS
Iva imbricata	Beach Elder	D/FS
Licania michauxii	Gopher Apple	D/FS
Muhlenbergia capillaris	Muhly Grass	W/PS
Opuntia humifusa	Prickly-Pear Cactus	·
Opuntia stricta	Prickly-Pear Cactus	·
Groundcovers		
Panicum amarum	Bitter Panicum	D/FS
Paspalum vaginatum	Knotgrass	M-W/FS
Salicornia spp.	Glasswort	·
Sesuvium portulacastrum	Sea Purslane	M-D/FS
Spartina patens	Marsh Hay/ Salt-meadow Cordgrass	D/FS
Sporobolus virginicus	Seashore Dropseed	D/FS
Uniola paniculata	Sea Oats	D/FS
Vines		
Canavalia maritima	Bay Bean	·
Echites umbellata	Devil's Potato	·
Ipomoea spp.	Morning Glory	D/FS
Passiflora incarnata	Passionflower	D-M/FS-PS
Passiflora suberosa	Corky-stem Passionflower	D-M/FS-PS
Urechites lutea	Wild Allamanda	·
Wildflowers		
Borrichia spp.	Sea-Oxeye Daisy	D/FS
Cassia spp.	Partridge Pea	·
Eustoma exaltatum	Seaside Gentian	·
Gaillardia pulchella	Blanket Flower	D/FS
Helianthus debilis	Beach Sunflower	D/FS
Ipomopsis rubra	Standing Cypress	·
Monarda puncata	Horsemint	D/FS
Oenothera humifusa	Seaside Evening Primrose	·
Salvia coccinea	Tropical Sage	D/FS
Verbena maritima	Beach Verbena	·

Xeric Uplands

Xeric Oak Scrub/Sand Pine Scrub - Scrub Forest

Canopy Trees		
Carya floridana	Scrub Hickory	D/FS
Pinus clausa	Sand Pine	D/FS
Quercus geminata	Sand Live Oak	D/FS
Understory Trees		
Ilex arenicola	Scrub Holly	·
Lyonia ferruginea	Rusty Lyonia	D/FS
Lyonia fruticosa	Staggerbush	·
Osmanthus megacarpa	Scrub Devilwood	·
Persea humilis	Silkbay	D/FS
Quercus chapmanii	Chapman's Oak	D/FS
Quercus inopina		·
Quercus myrtifolia	Myrtle Oak	D/FS
Shrubs		
Asimina obovata	Flag PawPaw	D/FS
Asimina pygmaea	Dwarf PawPaw	M/PS
Befaria racemosa	Tarflower	·
Bumelia tenax	Tough Bumelia	D/FS
Cyrilla racemiflora var. parvifolia	Scrub Titi	D/FS
Garberia heterophylla	Garberia	D/FS
Opuntia spp.	Prickly-Pear Cactus	·
Palafoxia feayi	Palafoxia	·
Sabal etonia	Scrub Palmetto	D/PS
Serenoa repens	Saw Palmetto	D/FS
Vaccinium darrowii	Blueberry	D/FS
Vaccinium myrsinites	Shiny Blueberry	M/FS-PS
Ximenia americana	Hog Plum	D/FS
Groundcovers		
Bumelia rufotomentosa	Dwarf Buckthorn	·
Calamintha spp.	Calamintha	·
Conradina spp.	Scrub Mint	D/FS
Hypericum reductum	St. John's Wort	D/FS
Licania michauxii	Gopher Apple	D/FS
Nolina brittoniana	Beargrass	·
Piloblephis rigida	Pennyroyal	D/FS
Yucca filamentosa	Beargrass	D/FS
Zamia pumila	Coontie	D-M/FS-PS
Vines		
Bonamia grandiflora	Florida Bonamia	·
Centrosema spp.	Butterfly Pea	·
Galactia spp.	Milk Pea	·
Wildflowers		
Asclepias tuberosa	Butterfly Weed	D/FS
Baldunia angustifolia	Yellow Buttons	·
Chrysopsis floridana	Florida Aster	·
Heterotheca subaxillaris	Camphor Weed	·
Liatris spp.	Blazing Star	M/FS
Pityopsis graminifolia	Golden Aster	D/FS
Polygonella spp.	Wireweed	·
Sisyrinchium solistitiale	Scrub Blue-Eyed Grass	·

Sandhill

Canopy Trees		
Pinus elliottii	Slash Pine	D/FS
Pinus palustris	Longleaf Pine	D/FS
Quercus laevis	Turkey oak	D/FS
Understory Trees		
Crataegus flava	Summer Haw	D/FS
Diopyros virginiana	Persimmon	D/FS
Quercus geminata	Sand Live Oak	D/FS
Quercus incana	Bluejack Oak	D/FS
Shrubs		
Asimina obovata	Flag PawPaw	D/FS
Callicarpa americana	Beautyberry	M/PS
Garberia heterophylla	Garberia	D/FS
Lyonia ferruginea	Rusty Lyonia	D/FS
Prunus angustifolia	Chickasaw Plum	M/PS
Prunus geniculata	Scrub Plum	·
Serenoa repens	Saw Palmetto	D/FS
Groundcovers		
Aristida stricta	Wiregrass	M-D/FS-PS
Licania michauxii	Gopher Apple	D/FS
Nolina brittoniana	Beargrass	·
Sporobolus junceus	Pineland Dropseed	·
Sorghastrum secundum	Lop-Sided Indiangrass	M/FS
Yucca filamentosa	Beargrass	D/FS
Vines		
Gelsemium sempervirens	Yellow Jessamine	M/PS
Lonicera sempervirens	Coral Honeysuckle	M/PS
Passiflora incarnata	Passionflower	D/FS
Wildflowers		
Asclepias tuberosa	Butterfly Weed	D/FS
Carphephorus corymbosus	Florida Paintbrush	D/FS
Chrysopsis scabrella	Golden Aster	·
Commelina erecta	Dayflower	·
Dyschoriste spp.	Twinflower	D/FS
Elephantopus spp.	Elephant Foot	·
Liatris spp.	Blazing Star	M/FS

Mesic Uplands

Hardwood Hammocks & Forests

Canopy Trees		
Carya glabra	Pignut Hickory	D/PS-S
Celtis laevigata	Sugarberry	M-S/S-FS
Fraxinus americana	White Ash	·
Liquidambar styraciflua	Sweetgum	M-D/FS-PS
Magnolia grandiflora	Southern Magnolia	M/FS-PS
Pinus taeda	Loblolly Pine	D/FS
Persea borbonia	Redbay	D/FS-PS
Quercus laurifolia	Laurel Oak	D/FS
Quercus michauxii	Chestnut Oak	·
Quercus nigra	Water Oak	D-M/FS-PS
Quercus shumardii	Shumard Oak	M-D/FS
Quercus virginiana	Live Oak	D/FS
Sabal palmetto	Cabbage Palm	D/FS

Tilia caroliniana	Basswood	·
Ulmus alata	Winged Elm	M-D/FS-PS
Understory Trees		
Acer saccharum subsp. Floridanum	Florida Maple	M/FS-S
Aesculus pavia	Red Buckeye	M-D/S-PS
Aralia spinosa	Devil's Walking Stick	
Carpinus caroliniana	Hornbeam	M-W/S-PS
Cercis canadensis	Redbud	D/FS-S
Chionanthus virginicus	Fringe Tree	D/FS
Cornus florida	Dogwood	D-M/FS-PS
Diospyros virginiana	Persimmon	D/FS
Ilex opaca	American Holly	D/FS-S
Juniperus silicicola	Southern Red Cedar	D/FS
Morus rubra	Red Mulberry	M/FS-PS
Ostrya virginiana	Hop Hornbeam	M-D/S-FS
Prunus caroliniana	Cherry Laurel	M/PS
Prunus umbellata	Flatwoods Plum	·
Sapindus marginatus	Soapberry	·
Shrubs		
Callicarpa americana	Beautyberry	M/PS
Erythrina herbacea	Coralbean	M-D/FS-PS
Foresteria ligustrina	Coralbean	·
Hamamelis virginiana	Witchhazel	M/PS
Ilex vomitoria	Yaupon Holly	D/FS-S
Rhapidophyllum hystrix	Needle Palm	M/S-PS
Rhododendron canescens	Wild Azalea	M/PS
Sabal minor	Bluestem Palmetto	D/PS
Groundcovers		
Dichanthelium spp.		·
Mitchella repens	Partridge Berry	·
Oplismenus setarius	Basketgrass	·
Thelypteris spp.	Shield Fern	W/PS
Zamia pumila	Coontie	D-M/FS-PS
Vines		
Bignonia capreolata	Cross Vine	M/FS
Gelsemium sempervirens	Yellow Jessamine	M/PS
Lonicera sempervirens	Coral Honeysuckle	M/PS
Parthenocissus quinquefolia	Virginia Creeper	M/FS
Wildflowers		
Ruellia caroliniensis	Wild Petunia	D/FS
Justicia cooleyi		·
Phlox floridana	Florida Phlox	·
Salvia lyrata	Lyre-Leaf Sage	M/FS
Vernonia gigantea	Giant Ironweed	·
Viola affinis	Forida Violet	M/FS

Pinelands/Pine Flatwoods

Canopy Trees		
Persea palustris	Redbay	M/FS
Pinus elliottii var. densa	South Florida Slash Pine	D/FS
Pinus elliottii var. elliottii	North Florida Slash Pine	D/FS
Pinus palustris	Longleaf Pine	D/FS
Pinus serotina	Pond Pine	·
Pinus taeda	Loblolly Pine	W/FS

Quercus nigra	Water Oak	M/FS
Quercus virginiana	Live Oak	D/FS
Sabal palmetto	Cabbage Palm	D/FS
Understory Trees		
Diospyros virginiana	Persimmon	D/FS
Ilex cassine	Dahoon Holly	M/FS
Shrubs		
Asimina pygmaca	Dwarf PawPaw	M/PS
Asimina reticulata	Pawpaw	M/PS
Befaria racemosa	Tarflower	·
Callicarpa americana	Beautyberry	M/PS
Hypericum galioides	St. John's Wort	D/FS-PS
Hypericum hypericoidies	St. John's Wort	D/FS-PS
Ilex glabra	Gallberry	M/PS
Lyonia ferruginea	Rusty Lyonia	D/FS
Lyonia fruticosa	Staggerbush	·
Lyonia lucida	Shiny Lyonia	·
Myrica cerifera	Wax Myrtle	·
Myrica pusilla	Dwarf Wax Myrtle	·
Quercus pumila	Runner Oak	·
Rhus copallina	Shining Sumac	·
Serenoa repens	Saw Palmetto	D/FS
Viburnum nudum	Possomhaw Viburnum	·
Groundcovers		
Andropogon virginicus	Broomsedge	M/FS
Aristida spp.	Wiregrass	M/FS
Dyschoriste spp.	Twinflower	D/FS
Lachnanthes caroliana	Redroot	·

Licania michauxii	Gopher Apple	D/FS
Mimosa strigillosa	Mimosa	M/FS
Muhlenbergia capillaris	Muhly Grass	W/PS
Sorghastrum secundum	Lop-Sided Indian Grass	M/FS
Vaccinium darrowii	Blueberry	D/FS
Vaccinium myrsinites	Shiny Blueberry	M/FS-PS
Woodwardia virginica	Virginia Chain Fern	M-W/PS-S
Zamia pumila	Coontie	D-M/FS-S
Vines		
Gelsemium sempervirens	Yellow Jessamine	M/PS
Parthenocissus quinquefolia	Virgina Creeper	M/PS
Wildflowers		
Asclepias tuberosa	Butterfly Weed	D/FS
Aster walteri	Walter's Aster	·
Carphephorus carnosus	Star Clusters	·
Carphephorus corymbosus	Florida Paintbrush	D/FS
Carphephorus odoratissimus	Vanilla Plant	·
Chysopsis scabrella	Golden Asters	·
Dichromena spp.	White-Top Sedge	·
Dyschoriste spp.	Twinflower	D/FS
Elephantopus spp.	Elephant Foot	·
Flaveria spp.	Yellowtop	M/FS
Helianthus angustifolius	Narrowleaf Sunflower	D/FS
Helianthus radula	Rayless Sunflower	D/FS
Liatris spp.	Blazing Star	M/FS

Lobelia spp.	Lobelia	M/FS
Monarda punctata	Horsemint	D/FS
Piloblephis rigida	Pennyroyal	·
Pityopsis graminifolia	Golden Aster	D/PS
Rhexia spp.	Meadow Beauty	·
Rudbeckia hirta	Black-Eyed Susan	M/FS
Salvia lyrata	Lyre-Leaf Sage	M/FS
Sisyrinchium atlanticum	Blue-Eyed Grass	·
Solidago spp.	Goldenrod	M/FS
Vernonia angustifolia	Ironweed	·
Xyris spp.	Yellow-Eyed Grass	·
Zephyranthes spp.	Rain Lily	M-W/PS

Wetland Plant Communities

Palustrine (Freshwater Wetlands)

Freshwater Marsh & Wet Prairie

Canopy Trees		
Salix caroliniana	Coastal Plain Willow	M-W/FS
Understory Trees		
N/A		
Shrubs		
Baccharis halmifolia	Saltbush	M-D/FS-PS
Cephalanthus occidentalis	Buttonbush	W/PS
Hibiscus coccineus	Scarlet Hibiscus	W/PS
Hibiscus grandiflorus	Swamp Hibiscus	M-W/FS-PS
Sambucus simpsonii	Elderberry	W/FS
Spartina bakerii	Sand Cordgrass	D/FS
Groundcovers		
Bacopa spp.	Water Hyssop	W/FS-PS
Canna flaccida	Yellow Canna	M/PS
Cladium jamaicense	Sawgrass	W/FS
Eleocharis spp.	Spikerush	M-W/FS-PS
Equisetum hyemale	Horsetail	W/FS
Juncus spp.	Rush	W/FS-PS
Lachnanthes caroliniana	Redroot	M-W/FS-PS
Ludwigia repens	Water Primrose	·
Osmunda cinnamomea	Cinnamon Fern	W/S
Osmunda regalis	Royal Fern	W/PS
Panicum hemitomon	Maidencane	W-M/FS-PS
Peltandra spp.	Spoonflower	·
Polygonum hydropiperoides	Smartweed	W-M/FS-S
Pontederia cordata	Pickerel Weed	W/FS-PS
Sagittaria spp.	Arrowhead	W/FS
Scirpus spp.	Bulrush	W/FS
Thalia geniculata	Alligator Flag	W/FS-PS
Zizania aquatica	Wild Rice	·
Vines		
Ipomoea spp.	Morning Glory	D/FS
Wildflowers		
Bidens mitis		·
Canna flaccida	Yellow Canna	M/PS
Crinum americanum	String Lily	W/FS-PS
Hydrolea corymbosa	Skyflower	·
Hymenocallis palmeri	Alligator Lily	·
Iris hexagona	Prairie Iris	M/PS

Pluchea rosea	Marsh Fleabane	·
Xyris spp.	Yellow-Eyed Grass	·
Aquatics		
Nelumbo lutea	American Lotus	·
Nuphar luteum	Spatterdock	·
Nymphaea mexicana	Yellow Water Lily	·
Nymphaea odorata	White Water Lily	W/FS
Nymphoides aquatica	Floating Hearts	·
Vallisneria americana	Tapegrass	·

Cypress Swamp/Cypress-Pine-Cabbage Palm

Canopy Trees		
Sabal palmetto	Cabbage Palm	D/FS
Quercus virginiana	Live Oak	D/FS
Understory Trees		
n/a		
Shrubs		
Callicarpa americana	Beautyberry	M/PS
Groundcovers		
n/a		
Vines		
n/a		
Wildflowers		
n/a		

Hardwood Swamp

Canopy Trees		
Acer rubrum	Red Maple	W/FS
Carya aquatica	Water Hickory	M-W/FS-PS
Magnolia virginiana	Sweetbay Magnolia	W/FS
Nyssa biflora	Swamp Tupelo	W/FS
Taxodium ascendens	Pond Cypress	W/FS
Taxodium distichum	Bald Cypress	W/FS
Understory Trees		
Cornus foemina	Swamp Dogwood	W-M/FS-S
Fraxinus caroliniana	Pop Ash	M-W/S-PS
Gleditsia aquatica	Waterlocust	·
Ilex cassine	Dahoon Holly	M/FS
Persea palustris	Redbay	M/FS
Salix caroliniana	Coastal Plain Willow	M-W/FS
Shrubs		
Cephalanthus occidentalis	Buttonbush	W/PS
Cyrilla racemiflora	Titi	W/PS
Hibiscus coccineus	Scarlet Hibiscus	W/FS-PS
Itea virginica	Virginia Willow	M/PS
Groundcovers		
Blechnum serrulatum	Swamp Fern	·
Canna flaccida	Yellow Canna	M/PS
Iris hexagona	Prairie Iris	M/PS
Ludwigia repens	Water Primrose	·
Orontium aquaticum	Golden Club	·
Osmunda regalis	Royal Fern	W/PS

Peltandra spp.	Spoonflower	·
Polygonum hydropiperoides	Smartweed	
Sarurus cernuus	Lizard's Tail	W/S
Thelypteris spp.	Shield Fern	W/PS
Vines		
Aster carolinianus	Climbing Aster	M/FS
Ipomoea spp.	Morning Glory	D/FS
Rosa palustris	Swamp Rose	·
Wildflowers		
Crinum americanum	String Lily	W/FS-PS
Hydrolea corymbosa	Skyflower	·
Hymenocallis occidentalis	Spider Lily	D/FS-S

Hydric Hammock

Canopy Trees		
Acer negundo	Boxelder	·
Acer rubrum	Red Maple	W/FS
Carya aquatica	Water Hickory	W/FS-PS
Carya glabra	Pignut Hickory	M/FS
Celtis laevigata	Sugarberry	M/FS
Chamaecyparis thyoides	Atlantic White Cedar	M/FS
Fraxinus pennsylvanica	Green Ash	W-M/FS-S
Gordonia lasianthus	Loblolly Bay	W/FS
Liquidambar styraciflua	Sweetgum	M/FS
Liriodendron tulipifera	Tulip Tree	M/FS
Magnolia grandiflora	Southern Magnolia	M/FS
Magnolia virginiana	Sweetbay Magnolia	W/FS
Persea palustris	Redbay	M/FS
Pinus taeda	Loblolly Pine	W/FS
Quercus laurifolia	Laurel Oak	M/FS
Quercus michauxii	Chestnut Oak	M/PS
Quercus nigra	Water Oak	M/FS
Sabal palmetto	Cabbage Palm	D/FS
Tilia caroliniana	Basswood	·
Ulmus americana	Florida Elm	M/FS
Ulmus alata	Winged Elm	M/FS
Understory Trees		
Aesculus pavia	Red Buckeye	M/PS
Agarista populifolia	Pipestem	M/S
Carpinus caroliniana	Hornbeam	M/S
Chionanthus virginicus	Fringe Tree	M/PS
Cornus foemina	Swamp Dogwood	·
Crataegus marshallii	Parsley Haw	·
Ilex cassine	Dahoon Holly	M/FS
Morus rubra	Red Mulberry	M/FS
Myrcianthes fragrans	Simpson Stopper	D/FS
Styrax americana	Snowbell	W/S-PS
Shrubs		
Amorpha fruticosa	Wild Indigo	·
Aronia arbutifolia	Red Chokeberry	·
Bumelia reclinata		·
Cephalanthus occidentalis	Buttonbush	W/PS
Euonymus americana	Hearts-a-Burstin'	M/S-PS
Illicium parviflorum	Yellow Anise	W/PS
Leucothoe axillaris	Doghobble	W/PS

Lyonia ligustrina	Maleberry	·
Lyonia lucida	Shiny Lyonia	D/FS-PS
Myrica cerifera	Wax Myrtle	M/FS-PS
Rhapidophyllum hystrix	Needle Palm	M-D/S-PS
Sabal minor	Bluestem Palmetto	D/PS
Salix floridana	Florida Willow	M-W/FS
Tripsacum dactyloides	Gamagrass	W/FS
Vaccinium corymbosum	Highbush Blueberry	M/PS
Viburnum dentatum	Arrowwood Viburnum	M-W/FS-S
Viburnum obovatum	Walter's Viburnum	W/PS
Groundcovers		
Blechnum serrulatum	Swamp Fern	·
Dryopteris ludoviciana	Southern Shield Fern	·
Nephrolepis spp.	Sword Fern	M-W/PS-S
Osmunda cinnamomea	Cinnamon Fern	W/S
Osmunda regalis	Royal Fern	W/PS
Thelypertis spp.	Shield Fern	W/PS
Woodwardia areolata	Netted Chain-Fern	W/PS-S
Vines		
Ampelopsis arborea	Woodbine	·
Aster carolinianus	Climbing Aster	M/FS
Berchemia scandens	Supplejack	·
Bignonia capreolata	Cross Vine	M/FS
Campsis radicans	Trumpet Creeper	M/PS
Decumaria barbara	Climbing Hydrangea	·
Pieris phillyreifolia	Pieris	·
Wildflowers		
Arisaema triphyllum	Jack-in-the-Pulpit	·
Conoclinum coelestinum	Blue Mist Flower	M/FS
Crinum americanum	String Lily	W/FS-PS
Lobelia cardinalis	Cardinal Flower	M/FS
Vernonia gigantea	Giant Ironweed	·
Viola affinia	Florida Violet	M/FS

Marine and Estuarine

Salt Marsh

Canopy Trees		
n/a		
Understory Trees		
n/a		
Shrubs		
Acrostichum danaeifolium	Leather Fern	W/PS
Baccharis halimifolia	Saltbush	M/FS-PS
Iva frutescens	Marsh Elder	D/FS
Lycium carolinianum	Christmas Berry	D/PS
Groundcover		
Bacopa monnieri	Water Hyssop	W/S-PS
Batis maritima	Saltwort	·
Cladium jamaicense	Sawgrass	W/FS
Cyperus odoratus	Sedge	·
Distichlis spicata	Saltgrass	M-W/FS
Eragrostis elliottii	Elliott Lovegrass	D/FS
Fuirena scirpoidea	Umbrella Sedge	·
Juncus roemerianus	Black Rush	·
Limonium carolinianum	Sea Lavender	·

Monanthochloe littoralis	Key Grass	·
Paspalum vaginatum	Knotgrass	M-W/FS
Salicornia spp.	Glasswort	·
Scirpus validus	Softstem Bulrush	W/FS
Sesuvium portulacastrum	Sea Purslane	D/FS
Spartina alterniflora	Smooth Cordgrass	W/FS
Spartina bakeri	Sand Cordgrass	D/FS
Spartina patens	Marsh Hay	D/FS
Sporobolus virginicus	Seaside Dropseed	D/FS
Vines		
n/a		
Wildflowers		
Aster tenuifolius		·
Solidago sempervirens	Seaside Goldenrod	M/FS

Mangrove Swamp

Canopy Trees		
Avicennia germinans	Black Mangrove	M/FS
Conocarpus erectus	Buttonwood	D/FS
Laguncularia racemosa	White Mangrove	W/FS
Rhizophora mangle	Red Mangrove	W/FS
Understory Trees		
n/a		
Shrubs		
Acrostichum danaefolium	Leather Fern	W/PS
Baccharis halimifolia	Saltbush	M/FS-PS
Lycium carolinianum	Christmas Berry	D/PS
Groundcovers		
Batis maritima	Saltwort	·
Borrichia frutescens	Sea-Oxeye Daisy	D/FS
Limonium carolinianum	Sea Lavender	·
Salicornia spp.	Glasswort	·
Vines		
n/a		
Wildflowers		
n/a		

Chapter Seven: Design Examples Using the Hydrozone Concept

Design Examples Using Microclimates, Hydrozones, and Native Plant Communities

Designing with the hydrozone concept means following the landscape design process shown in the Traditional and/or Ecological process flowcharts outlined in Chapter Five. As previously mentioned, the element that differentiates the two types of processes is the timing and integration of the Hydrozone Diagram into the design evolution. The following series of Design Examples will demonstrate some of the ways that the Hydrozone Diagram can respond conceptually to the site conditions and the client program on residential sites.

Using the Natural Community City Map of New Port Richey, a city on the southwestern coast of Pasco County, a township was chosen randomly in the northeast area: Section 32 Township 25 Range 16, or 25S16E032. Figure 7-1 shows the blue gridlines of the townships and the black outlines of New Port Richey's city limits. Circled in red, a typical small residential development, about 11 acres total, was randomly chosen as the Design Examples neighborhood.

Figure 7-1. Natural Community City Map at Close Range. (author.)

As explained in Chapter Six, the Natural Plant Community Maps are created using an existing GIS dataset from the Florida Fish and Wildlife Conservation Commission (FFWC) that includes descriptions of natural community types and disturbed land types. The dataset is a grid data source, and each grid cell measures 30 meters by 30 meters, or 9,688.46 square feet, which is nearly a quarter of an acre. The Natural Plant Community Maps are useful at a neighborhood scale for helping designers discern the range of plant community types that are likely to occur in the area. The New Port Richey Natural Plant Communities Neighborhood Map was used to focus on a neighborhood area and identify the plant community types represented there. This is a useful pre-site visit inventory tool for a designer.

The following map, Figure 7-2, shows the 11 acre residential development parcels map in the center, circled in red. The colored grid cells correspond to specific plant community types, as shown in the Pasco County Vegetation and Land Cover maps legend in Figure 7-3. The predominantly dark green area to the east and south is Hardwood Swamp; the area of brownish-green dispersed through the center is Pinelands; and the dark gray is High Impact Urban. Areas of Mixed-Pine Hardwood Forest are peppered throughout with Hardwood Hammock and Forest areas and a few areas of Cypress Swamp. The Disturbed/Transitional land cover type Shrub and Brushland is also represented.

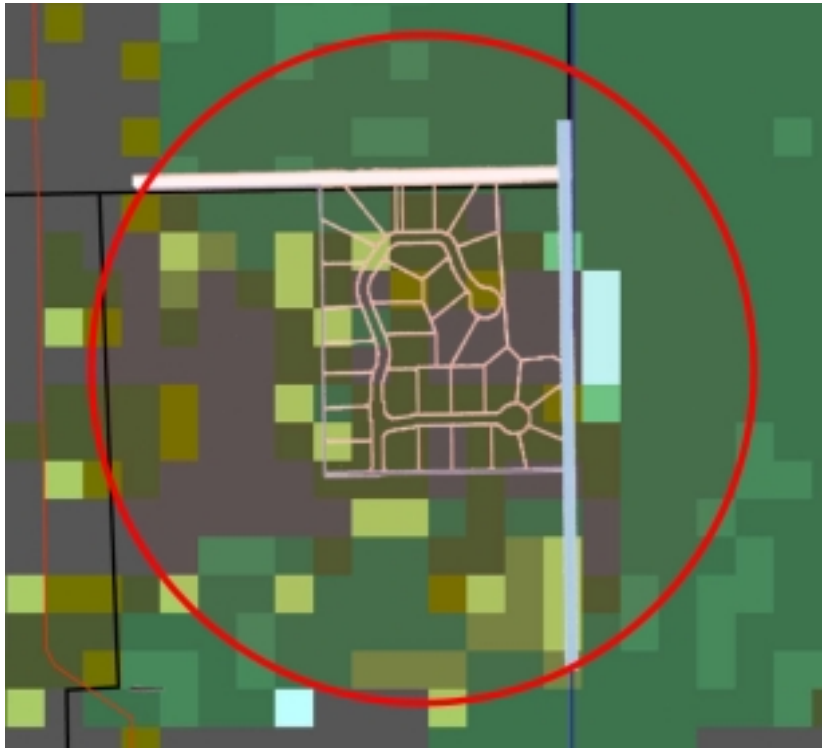


Figure 7-2. Small 11 Acre Residential Development Parcels with Natural Plant Community Data. (author.)

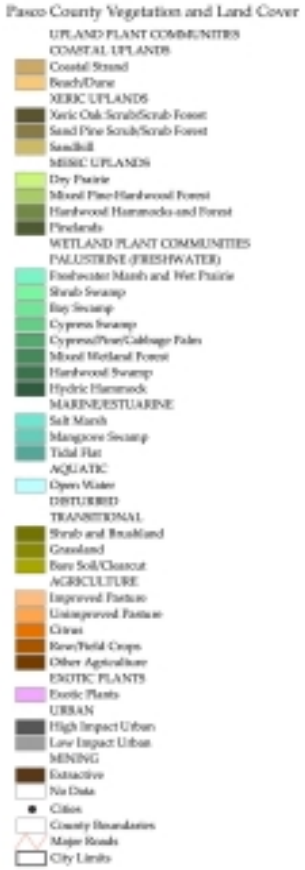


Figure 7-3. Pasco County Vegetation & Land Cover Maps Legend. (author).

Figure 7-4 shows a soils map of the residential development, along with a soil type legend from the Pasco County property appraiser website. The area on the far left is Tavares-Urban land complex, likely to be Poorly Drained compacted fill. The area in the middle, Pompano fine sand, is likely to be Well-Drained, since coarse and fine sands fall into the category of "light" soils. And on the far right, Sellers mucky loamy fine sand, is likely to be more Moderately Well-Drained, with the addition of loam to a fine sand (this can be confirmed during a site visit). Like the information from the Natural Plant Community Maps, soils information from the Pasco County website provides additional pre-site inventory research for the designer.

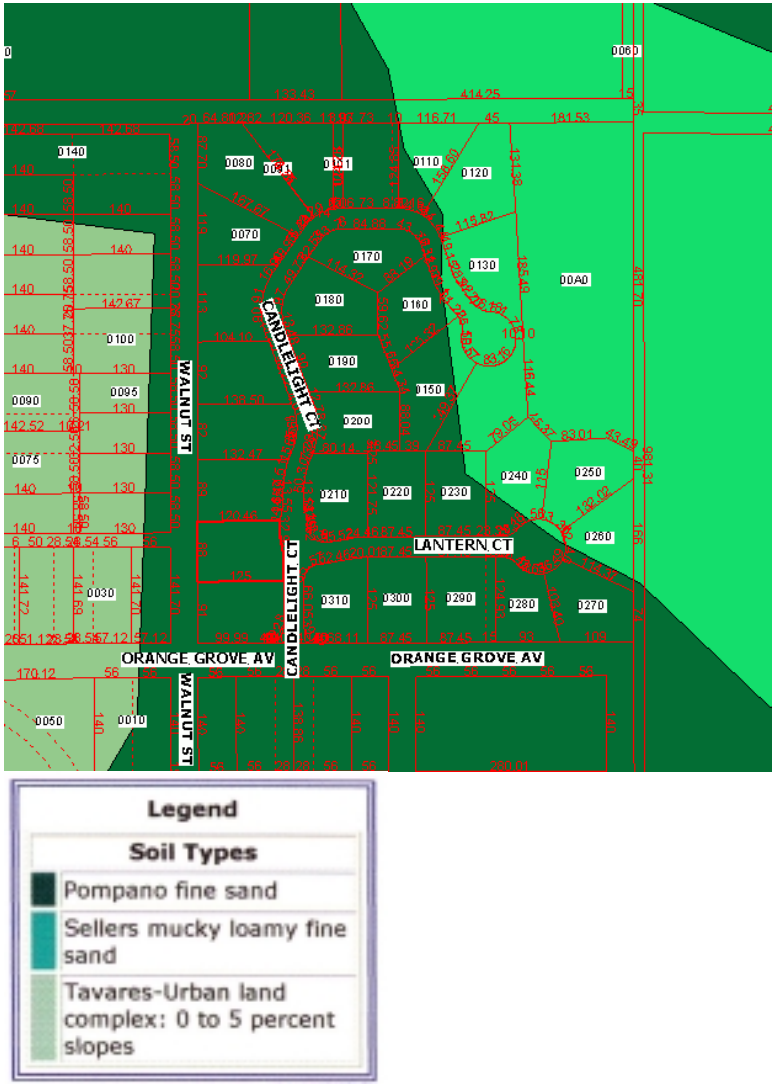


Figure 7-4. Soil Types Data for Residential Development. http://maps.pascogov.com/maps.

The sites chosen for the Design Examples are actual lots in a residential development in New Port Richey. The intention is not to redesign these lots or critique the existing landscape planning in any way. Instead, using "real" sites grounds the examples with "real" data on soils and natural plant community types. Three sites used to demonstrate the Design Examples are shown in Figure 7-5 and are outlined as follows:

1. **Site One: Disturbed ¼ Acre Residential Lot**
   Site Analysis/Synthesis and Program Needs
   Traditional Process: Hydrozone Diagram Alternative 1
   Traditional Process: Hydrozone Diagram Alternative 2

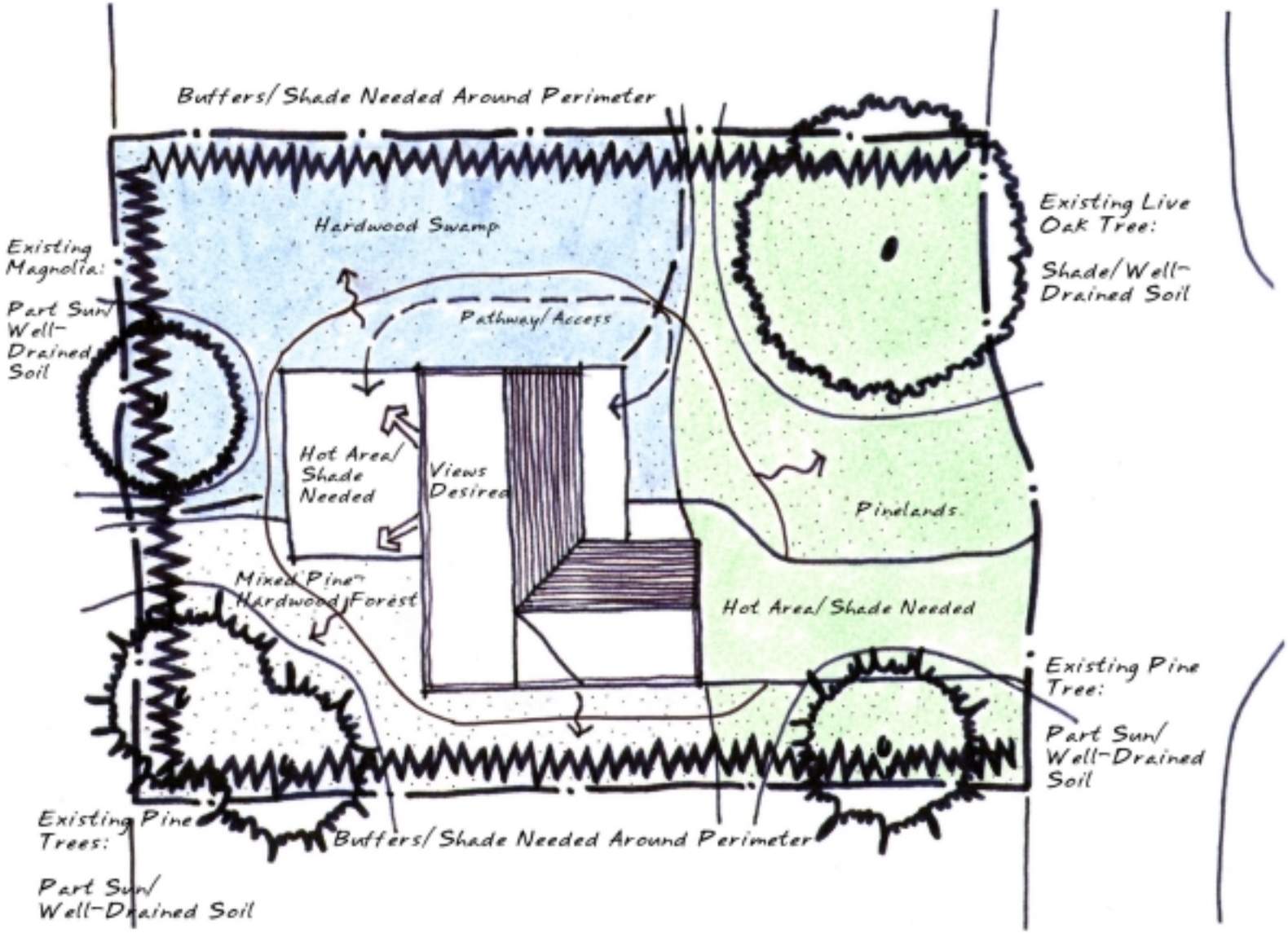
2. **Site Two: Semi-Natural Site, ½ Acre Residential Lot**
   Site Analysis/Synthesis and Program Needs
   Ecological Process: Hydrozone Diagram Alternative 1
   Ecological Process: Hydrozone Diagram Alternative 2

3. **Site Three: Natural Site, 1 Acre Residential Lot**
   Site Analysis/Synthesis and Program Needs
   Traditional Process: Hydrozone Diagram Alternative 1
   Ecological Process: Hydrozone Diagram Alternative 2

Figure 7-5. Three Design Example Sites from Residential Development. (author.)

All three sites use the same building footprint for the sake of simplicity: a typical suburban 1,550 square foot house with a two car garage. The patio/deck configurations are the only variations on the footprint.

Site 1: Disturbed ¼ Acre: Site Synthesis and Program Needs



Site 1: Site Synthesis and Program Needs

Site Synthesis

Soils: *From Pre-Site Visit Inventory*: Pompano Fine Sand (Well-Drained) / *From Site Visit Inventory*: Fill dirt under house footprint is similarly well-drained fill; however, the compaction of the footprint area and the fine sand probably renders it Moderately Well-Drained.

Vegetation: *From Pre-Site Visit Inventory* (Natural Community Map): 3 Native Plant Communities represented, Mixed Pine-Hardwood Forest in southeast of site; Hardwood Swamp in northwest of site, and Pinelands along eastern side. *From Site Visit Inventory*: Site is all cleared, except for 2 Loblolly and one Slash Pine, a Sweetbay Magnolia, and a mature Live Oak. (These plant types correspond with the natural plant community types identified on those areas of the site in the Pre-Site Visit Inventory.)

Topography: One lone contour line loops through the northwest portion of the site, creating a lower area there, in the Hardwood Swamp plant community area. The rest of the site was originally higher, so that water sheet flowed northwest, but since cut/fill and regrading, the highest area is now the building footprint, the next highest area encompasses the southwest, south, southeast, and northeast, and the lowest is still the northwest area, originally Hardwood Swamp.

Microclimates: Because the site has been entirely cleared (except for 5 trees), it remains hot and dry. The only shaded area is under the live oak, and in the areas around the pines and magnolia, there is filtered light, making small partly shady areas. The soil compaction was largely restricted to the

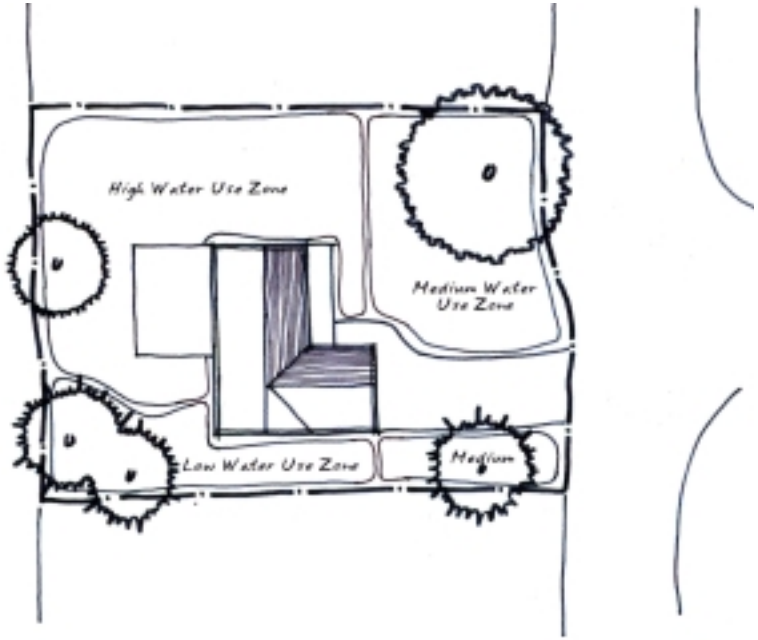
footprint, so the soil around the trees can still be classified as Well-Drained. The rest of the site is in full sun with well-drained and moderately well-drained soils.

Existing Structures: The 1,550 sq. ft. home was recently built on the site, and the driveway is freshly poured light-colored concrete, which contributes to the heat and albedo.

Program

- Buffers against the neighbors' yards are required around the perimeter, except where the site faces the street.
- Shade is needed throughout to cool the site, but the clients request it especially in the backyard patio area, where they intend to entertain frequently.
- The high use area of the patio will also require focal points to create some views within the yard (since there are no views off-site, and buffers will block views anyway).
- There are no needs or plans for the side yard on the south side of the site.
- Water in the front yard is expected to drain away from the house and into the curb-and-gutter system along the street; the driveway is graded for this purpose as well.

Site 1 Traditional Process: Hydrozone Diagram Alternative 1



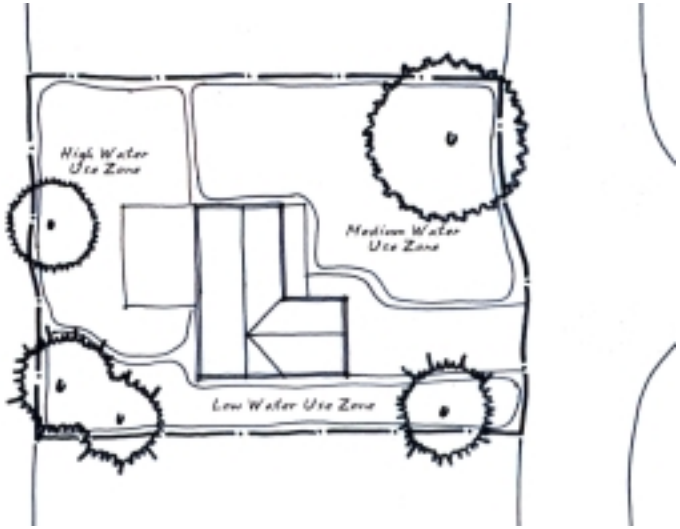
The first Hydrozone Diagram Alternative is based on a combination of site conditions and program elements. The clients' high-activity area (the back yard and patio) corresponds to the lowest and potentially more wet area of the site, so this will be the best area for the High Water Use (or Oasis) Zone. Within this zone, the designer can apply a variety of design solutions that would require more water use: an area of turfgrass, a vegetable or herb garden, and any "thirsty" plants that will enhance the aesthetics of the site—perhaps even a fountain. Shade trees or a pergola might help to cool the patio area, and large potted plants that require hand-watering could be included. As mentioned in Chapter Five, Xeriscape references suggest that the High Water Use Zone be designated around the entryways of buildings, since this is an area of high visibility, but because the homeowners plan to use the backyard and patio area more frequently, the high water use area should correspond with the high activity area.

The Medium Water Use (or Drought Tolerant) Zone includes the front yard area, where occasional irrigation (after establishment) will keep moderately thirsty plants alive. The

designer can take advantage of the shade provided by the mature live oak in this zone, as well. The clients need more shade, so seasonally flowering understory trees and shrubs might be a good choice to create a more welcoming entry and cool the area.

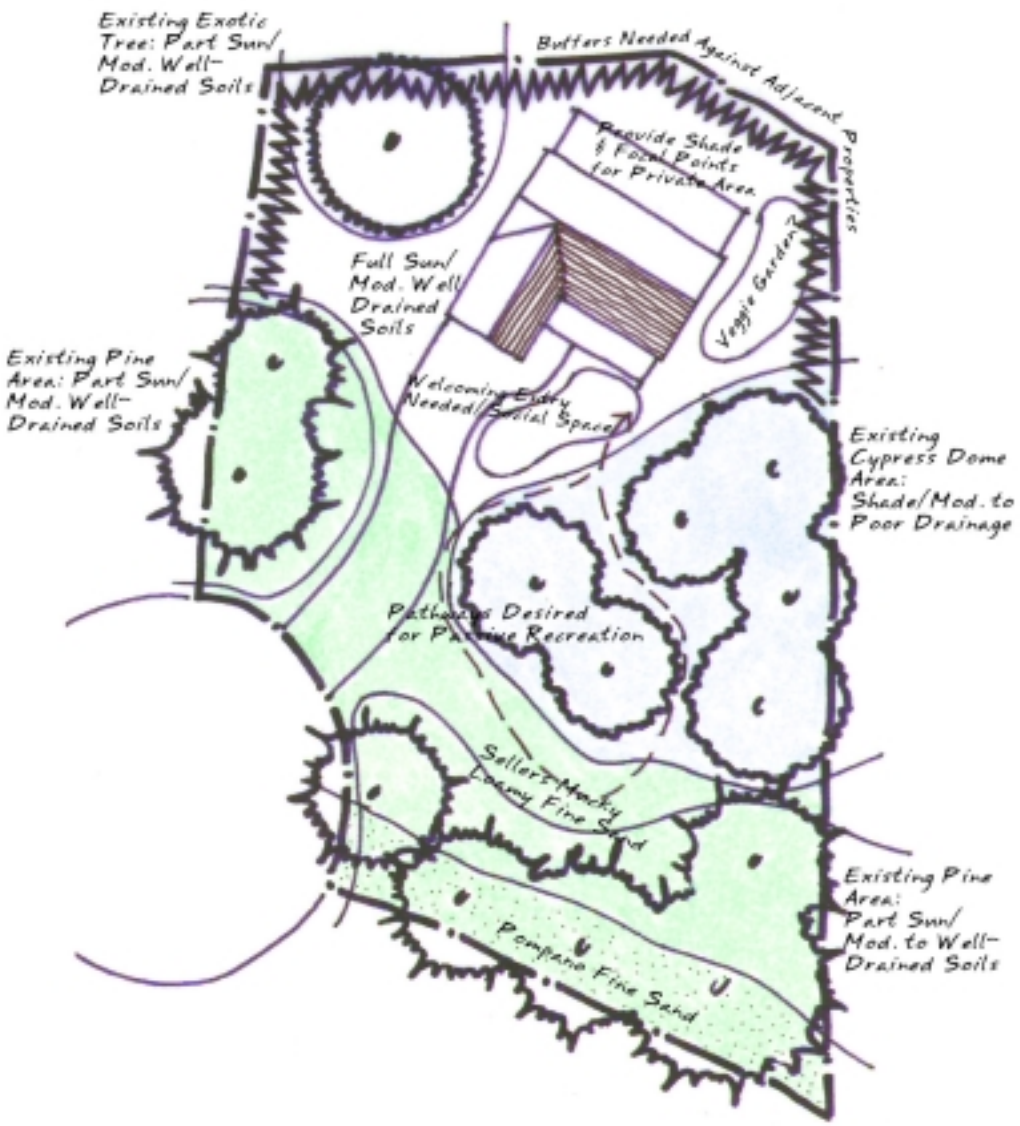
The Low Water Use (or Natural) Zone is confined to the southwest area of the side yard, where the clients will not extend maintenance beyond establishment irrigation. This area should be planted with shrubs and trees that will buffer sights and sounds from the neighbor's yard, and because the area will be free of human traffic, it could be planted with species that create small areas of habitat for urban wildlife.

Site 1 Traditional Process: Hydrozone Diagram Alternative 2



The second Hydrozone Diagram Alternative is a modification of the first alternative. The High Water Use area is reduced, and the Medium Water Use zone is expanded. The Low Water Use zone now extends the length of the property. These adjustments suggest that the same design concept can be used, but with some adjustments, greater water savings can result.

Site 2: Semi-Natural ½ Acre: Site Synthesis and Program Needs



Site 2: Site Synthesis and Program Needs

Site Synthesis

Soils: *From Pre-Site Visit Inventory*: Predominantly Sellers Mucky Loamy Fine Sand (Moderately Well-Drained) with one area in the southeast of Pompano Fine Sand. *From Site Visit Inventory*: The northern 1/3 acre of the site is disturbed/cleared with some areas of Transitional Shrub and Brushland, while the southern 2/3 acre of the site is natural and uncleared.

Vegetation: *From Pre-Site Visit Inventory*: The map shows the southern 1/3 acre of the site to be Pinelands, with an area of Cypress Swamp in the middle of the eastern boundary of the site. The northern 1/3 acre of the site is Urban/Disturbed. *From Site Visit Inventory*: The northern ¼ to 1/3 acre of the site has been cleared, and includes a large exotic tree in the northwest corner. The rest of the left has been left natural, and includes a cypress dome area on the eastern boundary, and along the south (both east and west) there is a mixture of Loblolly and Slash Pines with a thick understory of various plants, including Saw Palmetto, Gallberry, and Rusty Lyonia.

Topography: The site appears to slope down one foot or less in the area of the cypress dome, but elsewhere it is relatively flat, especially in the cleared area in the northern part of the site.

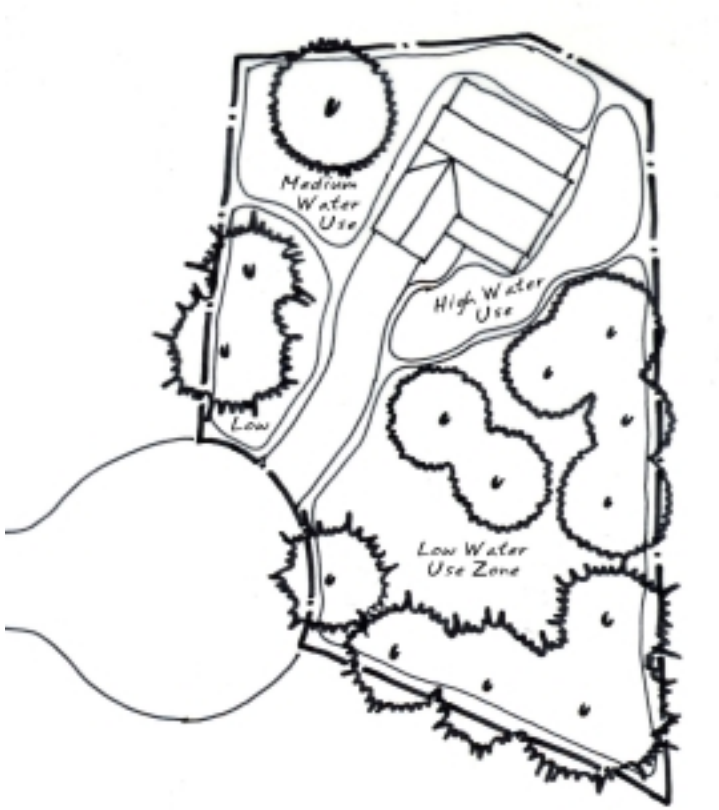
Microclimates: The pinelands area is partly sunny with moderately drained soils; the cypress area is shady with moderate to poor drainage, and the northern cleared/disturbed area is in full sun with moderately drained soils.

Existing Structures: The 1,550 sq. ft. home was recently built on the site.

Program

- Buffers against the neighbors' adjacent properties are needed in the northern area, behind the house.
- The homeowners feel that the exotic tree, a Camphor tree, is providing some shade and should stay on the site, but they want to use predominantly native plants for other landscape plantings.
- The homeowners would like to install a vegetable garden near the house, accessible to the kitchen.
- Shade is needed for the small backyard area, which will become a private area.
- The front entry will be a more public space, requiring a more landscape color and perhaps a patio space for socializing.
- The rest of the site, to the south and east, is to be left untouched, but the homeowners would like to clear a few pathways through the wooded areas, and clear some destination points for meditation spaces and family picnics.

Site 2 Ecological Process: Hydrozone Diagram Alternative 1



The first alternative, created using the Ecological Process for the Hydrozone Diagram, shows a clear delineation of space based on the existing microclimates on the site. The areas around the house are High and Medium Water Use Zones, and the rest of the site is designated Low Water Use.

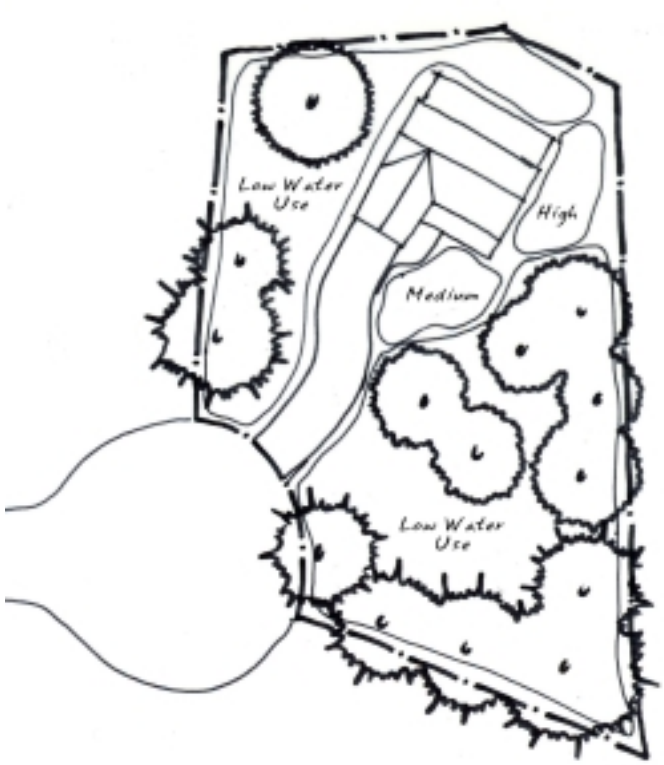
The High Water Use Zone covers the entry and just east of the house, where the site is already in full sun and moderately drained soil. These areas would be appropriate for the vegetable garden and the socializing/high activity area, where turfgrass would need to be irrigated.

The Medium Water Use Zone is just west of the house, using the existing Camphor tree to create additional activity areas with plantings requiring occasional irrigation, but without using turfgrass. A deck or other hardscaped area, like a patio, would be appropriate here for the program needs.

The Low Water Use zone encompasses the rest of the site, which should remain uncleared, except for pathways laid out by the designer. These paths should be cleared using small

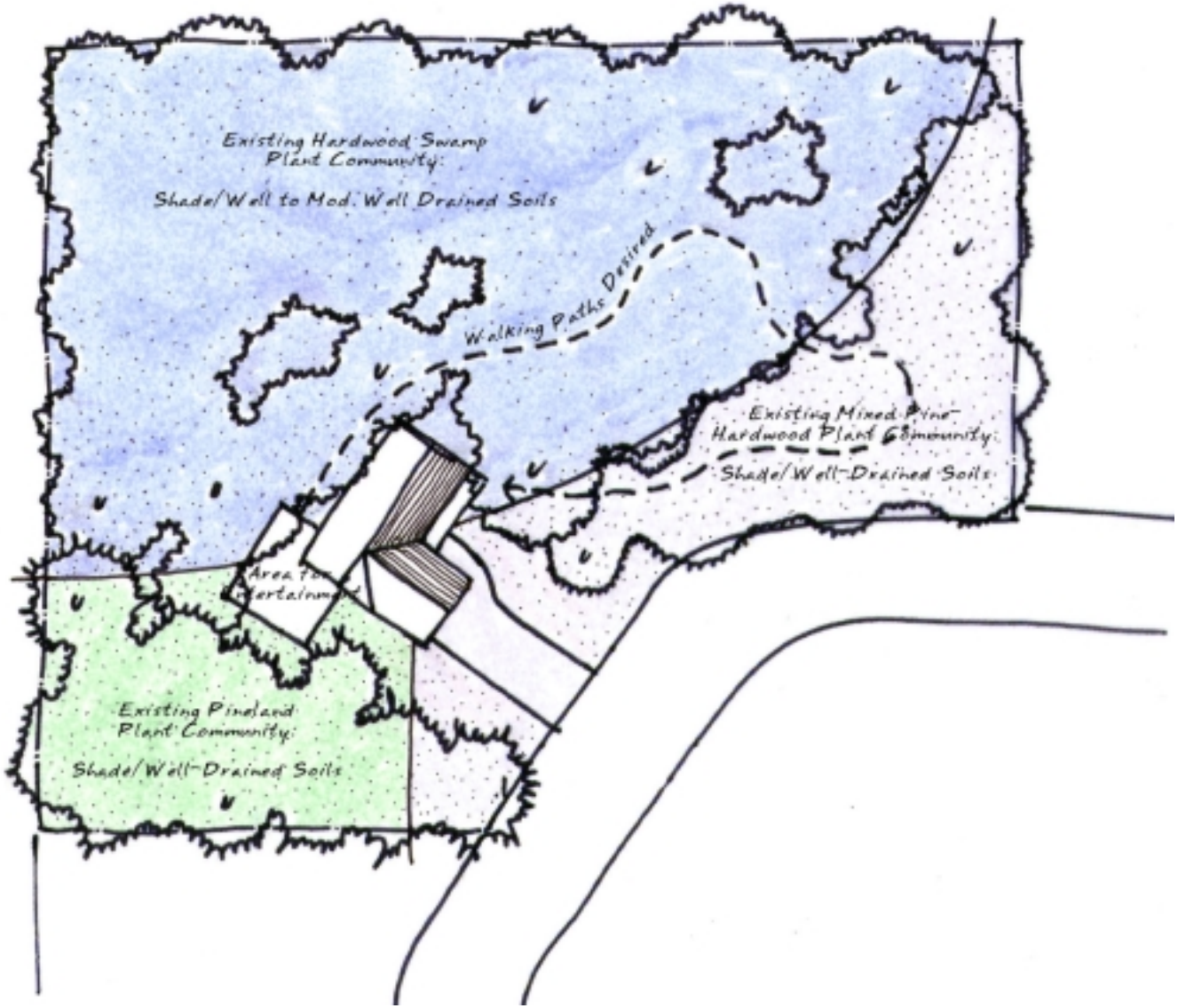
machinery or by hand to avoid unnecessary damage to the site, and might be "paved" with gravel or mulch.

Site 2 Ecological Process: Hydrozone Diagram Alternative 2



The second alternative for Site 2 follows the existing microclimates even more closely, confining the High Water Use zone to the vegetable garden area, creating a social spaces and a welcoming entry with Medium Water Use plantings and using native plants to landscape the northern area and back of the house so that the plantings will blend in with the surrounding native vegetation in time. The Low Water Use zone thus encompasses the rest of the site, which is completely preserved in the south and east except for the homeowners' pathways, and supplemented with native plants grouped by plant communities in all areas except the entry and vegetable garden.

Site 3: Natural 1 Acre: Site Synthesis and Program Needs



Site 3: Site Synthesis and Program Needs

Site Synthesis

Soils: *From the Pre-Site Visit Inventory*: The soils are Pompano Fine Sand (Well-Drained). *From the Site Visit Inventory*: The soils appear to be relatively consistent throughout the site, although the area of the northwest is loamy in some places, creating pockets of more Moderately Well-Drained soil.

Vegetation: *From the Pre-Site Visit Inventory*: The largest area, covering nearly half the site to the northwest, is identified as Hardwood Swamp. The smallest area in the southeast is Pinelands, and the area along the front of the property (facing the street) as well as the eastern boundary, is Mixed Pine-Hardwood Forest. *From the Site Visit Inventory*: The site is entirely wooded and uncleared except for the area immediately surrounding the house footprint. The original homeowners used the "envelope" method for constructing their home, leaving a 15' transition zone around the footprint, and allowing construction only within that zone. A fence protected the rest of the site from construction activity, and thus, it is completely preserved.

Topography: The site appears to be relatively flat.

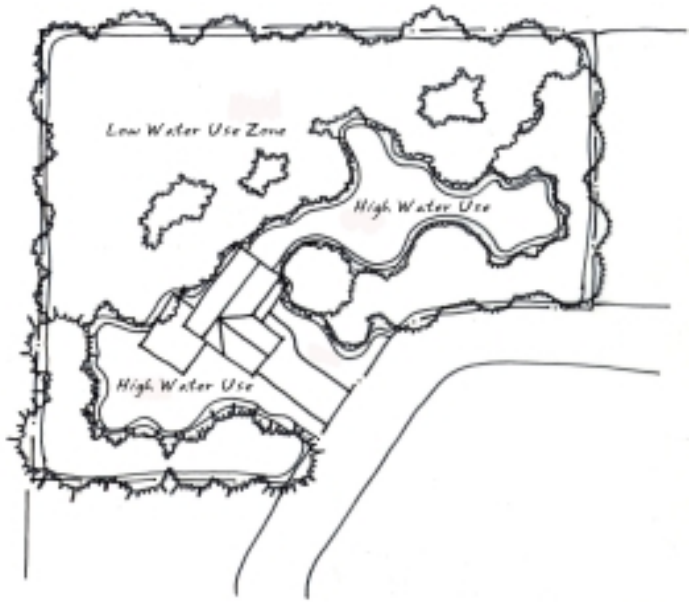
Microclimates: Since the site is largely preserved and heavily wooded, it is shady and cool, with well to moderately drained soils throughout. The area around the house is also shaded, since the area cleared during construction extended only 15' from the footprint.

Existing Structures: The 1,550 sq. ft. home was built on the site within the past few years; the driveway is constructed using concrete curbing to contain coarse gravel.

Program

- A space for entertaining is needed on the southeast corner of the house.
- Pathways to navigate through areas of the wooded site are desired, along with some cleared areas for private use.

Site 3 Traditional Process: Hydrozone Diagram Alternative 1



The first alternative for Site 3 is designed using the Traditional Process for the Hydrozone Diagram, which places a greater emphasis on program needs. In this alternative, the designer might clear areas of the wooded site, using turfgrass and other plantings to create a series of outdoor rooms that allow the homeowners to use the site more frequently and designate space for higher-intensity activities, such as installing a badminton net in one area, or a small water fountain with an arbor and bench for more passive recreation. The entertainment area southeast of the house continues this theme with an outdoor patio space designed for entertaining with a built-in grill and a stone fireplace. These program elements occupy a High Water Use zone, while leaving the rest of the site, preserved, in a Low Water Use zone.

Site 3 Ecological Process: Hydrozone Diagram Alternative 2

The second alternative for Site 3 was designed using the Ecological Process for the Hydrozone Diagram. In this scenario, the pathways are created for the homeowners with small machinery or by hand, resulting in shady, winding paths that open into larger cleared areas of sunlight. These destination points are landscaped with native plants appropriate for the native plant community in which the paths are created, so that temporary irrigation for establishment will leave them to blend in with the surrounding areas. Native wildflower seeds are planted in the sunnier cleared areas, and the paths are lined with gravel. Cleared areas provide passive recreation as well as more active use when needed. The entertainment space southeast of the house might be designed with a multi-level deck that takes advantage of the shade trees to create a tree house-like ambience. All of these program elements are created within a Low Water Use zone, with no thirsty plants or turfgrass selected for the site.

Chapter Eight: Sustainable Futures for Sustainable Designers

Sustainable Futures for Landscape Architects

"Where the landscape architect commands ecology he is the only bridge between the natural sciences and the planning and design professions, the proprietor of the most perceptive view of the natural world which science or art has provided….With the acquisition of this competence the sad image of ornamental horticulture, handmaiden to architecture after the fact, the caprice and arbitrariness of 'clever' designs can be dismissed forever. In short, ecology offers emancipation to landscape architecture."

From ***An Ecological Method*** *(1967), by Ian McHarg*

What does the future hold for landscape architects in Florida? Development trends indicate that our profession will continue to be in demand in our rapidly growing and environmentally sensitive state, as we try to balance economic prosperity with issues of carrying capacity. Within our profession, we seem to be moving toward redefining ourselves in new land stewardship roles and as promoters of sustainable practices. Perhaps these roles are not so new; as McHarg pointed out in 1967 (see Chapter Eight's introductory quotation), "ecology offers emancipation to landscape architecture."

Landscape architects often bemoan the fact that the general public seems to be unaware of what our profession entails, and that we must smile politely when well-intentioned but uninformed people invite us to renovate their backyards. Why not renovate their backyards as water conservation demonstrations? As this thesis project proves, serious conservation begins at home. Likewise, conserving our futures and redefining our professional roles begins *within*; while we often compete with other professions like engineering and

architecture, the interdisciplinary nature of our training and practice must always set us apart. McHarg's assertion that by using our knowledge of ecology, landscape architects become the only bridge between the natural sciences and the design professions is as true today as it was in 1967. Nevertheless, if our profession is to survive and thrive in the 21st century, we must learn to practice what we preach.

The 2004 ASLA Business Indicators Survey shows that the largest client group for landscape architects nationally is developers, and the second largest group is homeowners. When we have a great deal of influence in the process of land development and land planning, we can and must educate ourselves and our clients about sustainable development practices. Luckily, current trends favor ecological considerations; developers are slowly beginning to see that land preservation is a means of adding value to property rather than undue hardship. Homeowners, rather than professionals, may be driving this trend; landscape architects may simply be jumping on the bandwagon now that the time seems right. No matter the impetus, we happen to be uniquely suited to take on the challenges and interdisciplinary knowledge required to do "sustainable design." We are the "right" profession to embrace the sustainable design movement, and I challenge all landscape architects statewide to make Florida the "right place" to practice sustainably.

The Design Resources created and demonstrated in this thesis project were designed with the 21st century Florida landscape architect in mind. As comprehensive as our training can be, we must continue to educate ourselves and take every opportunity to put sustainable ideals into practical action.

Using the hydrozone concept as the basis for design is not a new concept, but it is a concept that needs a fresh eye and a fresh audience to take its practical measures into the realm of art. The Hydrozone Plant Selection Guide based on the hydrozone concept and created for use with the hydrozone diagram is a practical tool that will make it possible for the average code compliant landscape plan to become a successful example of sustainable design. Likewise, the Natural Community Maps and Plant Lists are educational as well as inspirational resources for the modern Florida landscape architect. Many professionals use GIS for large-scale planning endeavors, but seldom think of using GIS maps at the neighborhood level, or for information-gathering on soils and vegetation. Granted, most seasoned landscape architects can discern the native plant communities and soil types during the first site visit, but for those who cannot, or those new to the field, the Natural Plant Community Guide offers a resource for ecological landscape design based on sound scientific data and basic principles of plant ecology.

The practicality of these resources is intended to support the water-conservation goals of model landscape ordinances, but also the creative goals of the profession of landscape architecture. As McHarg writes, "the caprice and arbitrariness of 'clever' designs can be dismissed forever" when landscape architects learn to fuse the science of ecology with the beauty of art.

APPENDIX

Excerpts from Five Model Landscape Ordinances (See Chapter Five)

Ordinance Example 1: **From "Guidelines for Model Ordinance Language for Protection of Water Quality and Quantity Using Florida Friendly Lawns and Landscapes."**

9. GENERAL PROVISIONS AND DESIGN STANDARDS

C. Standards for land clearing and preservation of native vegetation

"…This ordinance mandates a total of X% percent of a site planned for development be set aside for preservation. When clearing, X% (to be determined by local government) of the native vegetation on the site shall be preserved. If vegetation is not present on the site, established open space zoning and landscape ordinance criteria shall be followed. / Vegetation that is set aside for preservation shall be protected from all on-site construction. Protective barriers shall be installed along the perimeter of all preserve areas. Protective barriers shall be constructed at such intervals to prevent machinery from passing between them. No equipment or materials shall be permitted to be stored within the set-aside areas, and dumping of excess soil, liquids, or any other construction debris within the preservation areas is prohibited. Any damaged vegetation within the set-aside areas shall be replaced with vegetation equivalent to the vegetation destroyed before any certificates of occupancy or other approvals may be issued. / Utilities, stormwater easements and right-of-ways are exempt but should avoid preserved areas. Although not specifically required, creative alternatives to common practice in these areas may be eligible for

incentives. / Areas that are considered to be of *high ecological importance* should be given highest priority for protection. These areas include, but are not limited to, areas that have occurrences of federal and state listed species of flora and fauna, areas of high biological diversity, and areas that are in aquifer recharge zones. / If more than one native terrestrial plant community is present on the site, areas representing all existing plant communities shall be preserved onsite unless preserving more of one particular community is more ecologically beneficial. / High-quality areas placed in preservation shall be retained in entirety, in their current or improved natural state, and protected into perpetuity regardless of ownership. This requirement may be negotiated to create contiguous preservation among plant communities. The developer shall prove to the reviewer, through exhibits provided during the site approval process, that the highest ecologically valued land is being retained first in order to satisfy the set-aside requirement. If the preservation of the highest ecologically valued land produces undue burden on the development of the property, it is also the developer's responsibility to prove such hardship and provide an acceptable alternative for approval. / Areas set aside for preservation should be contiguous parcels of land that are interconnected and considered valuable habitat for wildlife to the extent practical. Small fragmented areas of preservation should be avoided when possible…"

D. Appropriate Plant Selection, Location, and Arrangement

"Plant selection should be based on the plant's adaptability to the existing conditions present at the landscaped area and native plant communities, particularly considering

appropriate hardiness zone, soil type and moisture conditions, light, mature plant size, desired effect, color and texture. Plant species that are drought and freeze tolerant are preferred. For purposes of determining prohibited and controlled plant species refer to the Department of Agriculture and consumer Services rule, Chapter 5B-57 Florida Administrative Code. Plants named in this rule may not be used except as allowed in Chapter 5B-57. / Plants shall be grouped in accordance with their respective water and maintenance needs. Plants with similar water and cultural (soil, climate, sun, and light) requirements shall be grouped together. The water use zones (hydrozones) shall be shown on the irrigation, layout, and planting plans (where required). Where natural conditions are such that irrigation is not required, the presence of site appropriate plants shall not be considered a high water use hydrozone. / The combined size of all high water use hydrozones shall be limited to X% (to be determined by local government) of the total landscaped area. In landscapes irrigated with recycled water, the allowable size of all high water-use zones shall be increased to not more than X% (to be determined by the local government) of the total landscaped area. These high water-use limits do not apply to landscaped areas requiring large amounts of turf for their primary functions, e.g., ball fields and playgrounds."

Section E. Turf Areas.

"The type and location of turf areas shall be selected in the same manner as with all the other plantings. Irrigated turf areas, as opposed to non-irrigated turf areas, are considered to be a high water-use hydrozone. Irrigated turf shall not be treated as a fill-in material but rather as a planned element of

the landscape. Turf shall be placed so that it can be irrigated using separate zones. While turf areas provide many practical benefits in a landscape, how and where it is used can result in a significant reduction in water use. / Irrigated turfgrass areas shall be consolidated and limited to those areas on the site that receive pedestrian traffic, provide for recreational use, provide cover for septic tank drainfields and required drainfield reserve areas, or provide soil erosion control such as on slopes or in swales; and where turfgrass is used as a design unifier, or other similar practical use. No turfgrass that requires mowing shall be allowed on slopes greater than 4:1 or within 6 feet of the water's edge, except where adjacent seawalls and bulkheads are needed to control erosion. Turf areas shall be identified on the landscape plan (where plan is required). / One of the most common reasons for turf failure is over-irrigation. Irrigation systems shall be designed and operated in accordance with section F."

Ordinance Example 2: **From "Guidelines for Creation of Local Landscape Water Conservation Ordinances to Qualify for the St. Johns River Water Management District Ordinance Implementation Incentive Program"**

11. LAND CLEARING AND PRESERVATION OF NATIVE VEGETATION

11.1 Applicability

This section shall apply upon approval of this regulation to all permitted development on sites for which site plan, subdivision, or PUD review by the (to be inserted by the Local Government) is required prior to the issuance of a building permit at which native vegetation is present. A minimum of 10

percent of a site planned for development shall be set aside for preservation of native vegetation is present at the site. If native vegetation occupies less than 10 percent of the site, all available native vegetation shall be preserved. Individual single-family lots of one acre or smaller in size are exempt from this requirement; however, single family subdivisions and planned unit developments are not exempt.

11.2 Preservation standards

Vegetation that is set aside for preservation shall be protected from all on-site construction. Protective barriers shall be installed along the perimeter of all preserve areas. Protective barriers shall be constructed at such intervals to prevent machinery from passing between them. No equipment or materials shall be permitted to be stored within the set-aside areas, and dumping of excess soil, liquids, or any other construction debris within the preservation areas is prohibited. Removal or re-grading of soils within preservation area is prohibited. Any damaged vegetation within the set-aside areas shall be replaced with vegetation equivalent to the vegetation destroyed before any Certificates of Occupancy or other approvals may be issued. / Areas that are considered to be of *high ecological importance* should be given highest priority for protection. These areas include, but are not limited to, areas that have occurrences of federal and state listed species of flora and fauna, areas of high biological diversity, and areas that are in aquifer recharge zones. / High-quality areas placed in preservation shall be retained in entirety, in their current or improved natural state, and protected into perpetuity regardless of ownership. The developer shall prove to the reviewer, through exhibits provided during the site approval

process, that the highest ecologically valued land is being retained first in order to satisfy the set-aside requirement. If the preservation of the highest ecologically valued land produces undue burden on the development of the property, it is also the developer's responsibility to prove such hardship and provide an acceptable alternative for approval. / Areas set aside for preservation should be contiguous parcels of land that are interconnected and considered valuable habitat for wildlife to the extent practical. Small fragmented areas of preservation should be avoided when possible. Rights-of-way and areas determined to be future rights-of-way in the comprehensive plan, and utility or drainage easements shall not be allowed as designated preservation areas. / Land set aside as green space in compliance with other regulations (e.g. buffers, open space, etc) may serve to fill the native vegetation requirement is the vegetation that is set-aside meets the requirements set forth in these standards, is maintained as-is, and no permanent irrigation is used. Temporary irrigation may be used during a 90-day establishment period of restoration or re-creation. / Deed restrictions or other legal instruments which require future protection of the natural plant community areas, whether restored, re-created or preserved on-site, shall be required by any PUD or subdivision developer. / Areas that are set aside may have multiple uses assigned to them (e.g. passive recreation) provided that such uses do not damage native vegetation or alter the character of the plant community. Provisions for graded, permanent, or paved trail systems, roads, or other constructed features that displace native vegetation within a

preservation area shall not be included in the calculation of the preserved area.

11.3 Off-site preservation

At the option of the developer and in lieu of preserving native vegetation on-site, the developer may donate to the City/County, or a designee of City/County's selection, an area of existing native vegetation off-site. The amount of land to be donated offsite shall be equal to twice the amount of land required to be set-aside on site. In addition, the land off-site that is to be placed into preservation shall be of equal or better ecological quality. In no event shall the land being set-aside as off-site preservation be used to fulfill the set-aside of the property where off-site preservation is occurring.

11.4. Water conservation fund

At the option of the developer and in lieu of fulfilling the requirements of this ordinance on-site, or donating land off-site, the developer may contribute to the City's/County's Water Conservation Fund. The Water Conservation Fund will be used by the City/County for the purchase of land, or interests in land, which will be preserved in a natural condition to serve as aquifer recharge areas or for other water conservation or ecological purposed. The amount of money to be contributed to the Water Conservation Fund shall be equal to twice the assessed value of the property that otherwise would be set aside.

11.5. Control of undesirable plants

All invasive exotic plant species, as specified in Department of Agriculture and Consumer Services as "Noxious Weeds" rule

Chapter 5B-57, F.A.C. shall be removed from each site prior to the beginning of construction.

12. LANDSCAPE

12.1 Appropriate plant selection and location.

Plant selection for landscaped areas should be based on the plant's adaptability to the existing conditions present at the landscaped area, particularly considering appropriate hardiness zone, soil type and moisture conditions, exposure to sun, and mature plant size. Plants selected must be suited to withstand the soil and physical growing conditions found in the microclimate of each location on a site with supplemental irrigation only during periods in which rainfall has been less than one inch in the last seven days.

12.2 Limitation of turfgrasses. Turfgrass may be installed in up to 4,000 sq. ft. of landscaping on a single family residential lot without restriction. Turfgrass may be installed on no more than 50% of the remaining landscape area greater than 4,000 sq. ft. on a single family residential lot. / Commercial and industrial, municipal and multi-family residential properties shall be limited to a maximum of 1,200 sq. ft. of turfgrass per developed acre.

12.3 Turfgrass and plant placement. Plants shall be grouped in accordance with their respective water and maintenance needs to provide for efficient irrigation. Plants with similar water and cultural (soil, climate, sun, and light) requirements shall be grouped together in hydrozones. Hydrozones shall be shown on the irrigation and planting plans when required. / Turf shall be placed so that it can be irrigated using separate irrigation zones from other plants. / No turfgrass that requires mowing shall be allowed on slopes greater than 3:1 or within 6

feet of the water's edge, except where adjacent to seawalls and bulkheads or needed to control erosion. Turf areas shall be identified on the landscape where such plan is required.

Ordinance Example 3: **From "Homestead, Florida, Landscape Ordinance."**

Sec. 29-7. Landscape plan review criteria. All landscape plans shall be reviewed by the Development Services Department. Landscape plans shall be reviewed in accordance with FYN "Florida-friendly" landscaping principles, the guidelines and illustrations provided in the Landscape Manual, and the following goals and objectives: ….[(b) Existing specimen trees, native vegetation (including canopy, understory, and ground cover) and Natural Forest Communities shall be preserved to the maximum extent possible and meet all requirements of Section 29-60 of the Code.] / (c) To conserve water, reduce maintenance, and promote plant health, plant species shall be selected and installed based on their water needs, growth rate and size, and resource inputs. Plants with similar water needs shall be grouped in hydrozones. Adequate growth area, based on natural mature shape and size, shall be provided for all plant materials. / (d) The plan shall include the use of locally adapted native plant species to re-establish and aesthetic regional quality and take advantage of the unique diversity and adaptability of native plant species to the environmental conditions of South Florida. Where feasible, the re-establishment of native habitats shall be incorporated into the landscape plan. / (e) Trees and shrubs shall be planted in the energy conservation zone where feasible, to reduce energy

consumption by shading buildings and shall be used to reduce the heat island effects by shading paved surfaces. / (f) Drought-tolerant street trees shall be used to shade roadways and provide visual order. Where feasible, selected species shall be used to establish hierarchy by defining different road types. / (g) Special attention shall be given to the use of appropriate species located under or adjacent to overhead power lines, and near native plant communities and near underground utility lines. Adequate growth area shall be provided for all plant materials. / (h) Landscaping shall be designed in such a way as to provide safe and unobstructed views at intersections of roadways, driveways, recreational paths and sidewalks. / (i) Historic landscapes and landscape features designated by local, State or federal governments shall be preserved.

Sec. 29-6. Minimum standards.

(a) Lawn area (turf).

(1) Lawn areas shall be planted with species well adapted to localized growing conditions in Homestead. Lawn areas may be sodded, plugged, sprigged, hydromulched, or seeded except that solid sod shall be used in swales or other areas subject to erosion. In areas where other than solid sod or grass seed is used, overseeding shall be sown for immediate effect and protection until coverage is otherwise achieved.

(2) Exclusions from maximum permitted lawn areas:

a. Stabilized grassed area used for parking;

b. Grassed areas designated on landscape plans and actively used for sports, playgrounds, or picnic areas;

c. Grassed areas in the right-of-way;

d. Stormwater retention/detention areas planted in grasses that are very drought tolerant, as referenced in the Landscape Manual and the FYN 'Florida-friendly' landscaping principles, as well as tolerant of wet soils.

(3) The maximum permitted lawn area (the portion of required open space that may be planted with lawn grasses) for all residential and mixed uses is referenced in Table A.

(4) The maximum permitted lawn area for all office, commercial, and industrial uses is as referenced in Table A. Very drought tolerant grasses and low growing native plants, including grasses and forbs, as referenced in the Landscape Manual, may be used as groundcover beyond the maximum permitted grass area specified in Table A.

(5) The maximum amount of lawn area for residential and mixed uses shall be limited to a maximum of sixty (60) percent of the required landscaped open space. In those residential and mixed use zoning districts where landscaped open space is not specified, lawn areas shall be restricted to a maximum twenty (20) percent of the net lot area less the area covered by buildings. Very drought tolerant grasses and low growing native and/or drought tolerant plant species, including grasses and forbs, as referenced in the Landscape Manual, may be used as groundcover beyond the maximum permitted grass area.

Ordinance Example 4: From "Sarasota County Water Efficient Landscape Ordinance."

Section 22-153. Definitions

For the purpose of this article, the following words and phrases shall have the meanings respectively ascribed to them by this section.

All words used in the present tense include the future; all words in the singular number include the plural and the plural the singular; the word 'structure' includes the word 'building;' the word 'shall' is mandatory. The word 'used' shall be deemed to include the words 'arranged,' 'designed,' or 'intended to be used.' Any word or term not interpreted or defined by this section shall be used with a common dictionary meaning of common or standard utilization.

….

Landscaped Area. The entire parcel less the building footprint, driveways, non-irrigated portions of parking lots, hardscapes such as decks and patios, and other non-planted areas. Water features are included in the calculation of the landscaped area. This landscaped area included Xeriscape as defined in 373.185(1)(b), F.S.

….

Plant Bed. A grouping of trees, shrubs, and/or ground covers growing together in a defined area devoid of turfgrass, normally using mulch around the plants.

….

Water Use Zone. A grouping of sprays, sprinklers, or micro-irrigation emitters that can be operated simultaneously by the control of one valve according to the water requirements of the plants used.

….

Section 22-154. General Provisions and Design Standards

(a) Landscape Planning and Installation

(1) Plants with similar water requirements shall be irrigated on the same zone. Installed trees and other vegetation shall be spaced and located to accommodate their mature size on the site and not interfere with irrigation spray patterns of coverage. No plants shall be planted under roof overhangs. When utilizing organic mulch a minimum depth of 3" shall be applied in plant beds and around individual trees and palms.

(2) High Irrigated Water Use Zone – An area of the site that shall be limited to a maximum of fifty (50) percent of the total irrigated landscape vegetated area. Plants and turf within this area require supplemental water throughout the year in addition to natural rainfall to survive or grow. This zone consists of turfgrass varieties, annual flowers, and residential vegetable gardens.

(3) Low Irrigated Water Use Zone – An area of the site containing plants that require supplemental water only during seasonal dry periods.

(4) Impervious surfaces and materials within the planted portion of the landscaped area shall be limited to borders, walkways, stepping stones, and other similar materials, and shall not exceed 10% of the landscaped area.

(5) The type, location, and shape of turf areas shall be determined in the same manner as with all other plantings. Turf shall be placed so that it can be irrigated separately. Turf areas shall be no narrower than four (4) feet except when next to landscaping on contiguous properties.

Ordinance Example 5: **From "Model Water Efficient Irrigation and Landscape Ordinance Developed for Tampa Bay Water Member Governments."**

Section 1. Purpose

The purpose of this ordinance is to ensure efficient water use by establishing minimum standards for landscape and irrigation design, recognizing the Tampa Bay watersheds' climate, soils, water resources, land use, and resource planning. Implementation will aid in improving environmental quality and water use efficiency in the Tampa Bay region. Creative site development concepts shall be used in order to promote water conservation. Water requirements may be reduced by providing for:

- The preservation of existing plant communities;
- The use of site specific plant materials;
- The use of pervious paving materials;
- The use of water efficient irrigation; and
- Other environmentally sensitive site development concepts;
- Utilization of applicable best management practices.

Section III. Irrigation

The Florida Irrigation Society (FIS) Standards (third edition, February 1996, as amended) should be used for all irrigation design and installation procedures, except where the requirements of this Ordinance supercede the FIS Standards.

Irrigation Zone Design – A site plan, at a readable and defined scale, shall be submitted illustrating the proposed irrigation zones, delineating micro-irrigation zones and areas utilizing irrigation techniques other than micro-irrigation.

Fifty (50) percent of the on-site green space shall be allowed to utilize irrigation techniques other than micro-irrigation. Turf areas shall be on separate irrigation zones from other landscape plant zones. The irrigation system should be designed to accommodate separate landscape plant zones based on differing water requirements….

Section IV. Landscape

Landscape Plan – Using the concept of a "Florida Friendly Landscape" or Xeriscape™, a site plan shall be submitted identifying all existing vegetation to be preserved, proposed turf, and other landscape areas. Installed trees and plants should be grouped together into landscape plant zones according to water and cultural (soil, climate, and light) requirements. Plants groupings based on water requirements are as follows: natural, drought tolerant, and oasis.

Turf/Turfgrass – A maximum of 50% of greenspace may be planted with turfgrass configured with a permanent irrigation system. Turfgrass planted in excess of this limitation shall not have a permanent irrigation system. Micro-irrigation shall not be used on turfgrass…..

Section VI. Definitions

….

Drought Tolerant Plants – Plants, once established, that survive on natural rainfall with occasional irrigation during dry periods.

….

Natural Plants – Plants, once established, that survive on rainfall without irrigation.

Oasis Plants – Plants, once established, requiring frequent irrigation.

….

Xeriscape™ or Florida Friendly Landscape – (as provided for in § 373.185 Florida Statutes) quality landscapes that conserve water and protect the environment and are adaptable to local conditions and which are drought tolerant. The principles of Xeriscape™ include planning and design, appropriate choice of plants, soil analysis which may include the use of solid waste compost, efficient irrigation, practical use of turf, appropriate use of mulches, and proper maintenance.

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I certify that I have read this study and that is my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a final project for the degree of Master of Landscape Architecture.

Glenn A. Acomb — Professor's name
Associate Professor — Professor's title
Landscape Architecture — Department name

MARGARET H. CARR — Professor's name
ASSOCIATE PROFESSOR — Professor's title
LANDSCAPE ARCHITECTURE — Department name

This project was submitted to the Graduate Faculty of the College of Design, Construction and Planning and was accepted as partial fulfillment of the requirements for the degree of Master of Landscape Architecture.